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WITH

International Abstract of Surgery

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THE SURGICAL SIGNIFICANCE OF HEPATIC INCOMPETENCY[1]

BY WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

THE Great War brought to a close a period in scientific surgery, of which Dr. John B. Murphy was the most brilliant exponent. This period was characterized by the advancement of the principles of surgery, investigation of the relation of microorganisms to disease, and the development of clinical medicine on a pathological basis. Animal experimentation and the test tube marched side by side with clinical surgery and illumined many dark pages in our understanding of the phenomena of disease. The development of clinical surgery during the last generation was essentially regional, and in this development no one played so great a part as the distinguished man in whose honor this annual address is given.

Briefly to call attention to just what Murphy accomplished and the breadth and scope of his genius, we may cite his contributions to abdominal surgery for which he first became known. The Haymarket riots brought his name into prominence. While Bull preceded Murphy in the successful repair of gunshot wounds of the intestine, the brilliance of Murphy's performance gave vitality to Bull's exploit, and Murphy followed his operative work by promulgating the surgical principles governing gunshot wounds of the abdomen which guide us today. Murphy's early grasp of the appendicitis problem was equally firm and sure. His paper "Ileus," published in 1896, is one of the most valuable contributions to American surgery, and even today we fail to realize the importance of the parallel artery of the small intestine without corresponding veins which Murphy pointed out as a frequent cause of gangrene of the obstructed intestinal wall. We speak of "cutting off" the circulation in any part of the body when we usually mean the opposite. When the arterial circulation is cut off "white death" follows, a rare form of necrosis. "Black death" is the usual condition, the arteries continuing to carry blood into the involved gut, the obstructed venous flow choking the doomed area. Murphy also made valuable contributions to the study of tuberculosis of the peritoneum, pointing out that it is secondary to a local focus, and his genius was particularly manifest in clearing up moot points in the surgery of the biliary tract.

Murphy's mind, while never abandoning an accepted field of research, ever turned to new and unexplored regions of the body. His oration on "Thoracic Surgery," before the American Medical Association in 1898, brought out work of a fundamental character, showing the effect of the size of external pleural openings on collapse of the lungs, and that the diaphragm is essentially the piston of a thoracic pump. In surgery of the nervous system his contributions were equally important, stressing the fact that peripheral nerves divided proximal to the ganglion never regenerate and that a complete severance of the spinal cord due to injury is irreparable. In surgery of the vascular system, also, he

[1] The Second John B. Murphy Oration in Surgery, delivered before the Clinical Congress of American College of Surgeons, in Philadelphia, October 24–28, 1921.

dealt with fundamental problems and successfully sutured large vessels; his work in this field has been the basis of productive research. The more recent contributions which were made by him during the years immediately preceding his too early demise were in surgery of the bones and joints, where he greatly assisted orthopedic surgery to free itself from the shackles of the harness maker.

Other surgeons of Murphy's day and generation may be compared with him in various limited fields of surgical endeavor, but we must remember the number of targets into which he shot and that he always rang the bell.

Murphy was a voluminous writer and greatly enriched surgical literature. By these printed pages posterity will know him, but to those of us who have been inspired by his magnetic personality and who have, with rapt interest, followed his clinical teachings, visible evidences of the printed page are but the ghost hovering over the grave of the greatest surgeon of the last generation.

As the result of many causes, of which the profound influence of the Great War may be counted as one, we see, perhaps dimly, that surgery is taking on a new aspect. It is no longer possible for the individual surgeon, in the face of the enormous amount of new and, as yet, unorganized knowledge, to cover the ground that Murphy covered.

I knew Murphy well; his was not the nature that desired praise, but with the divine spark he desired ever to kindle new fires under old misconceptions. Therefore, in our annual memorial tribute to Murphy we should strive to emulate his standards and devote our endeavors to the advancement of the science of surgery, even as he devoted his life to this cause.

Our day of higher specialization and the correlation of the work of specialists in many fields is the foundation on which future progress depends. We see this exemplified in the study of shock in its relation to the nervous system as influencing operation, in the closer study of the heart, and the effect that changes in the vascular system may have on surgical conditions. We are beginning to recognize that although respiratory failure is the most frequent immediate cause of the termination of life, the material cause which produces the terminal pulmonary catastrophe is usually brought to the lungs through the blood stream, seldom by way of the respiratory passages, and that the influence of the anæsthetic is slight in producing postoperative pulmonary complications after surgical operations, which are equally frequent after local anæsthesia, nitrous oxide and oxygen, and ether. We are also gaining knowledge of the relation of the incompetence of the kidney to the cause of death. We have found that the kidneys do not secrete urine, but filter urine, and that with the urine are eliminated body waste and toxic products strained from the general circulation, that the kidneys are not often the primary cause of death, kidney failure being due to overload, and the development of acute conditions on pre-existing lesions. Studies of the blood have, therefore, become of the utmost importance because we recognize as never before that the toxic material which produces these wide-spread manifestations may affect more specifically certain of the vital organs. As shown by Rosenow, the bacteria and other toxic bodies are carried through the blood stream to the organs which they damage and lead to surgical complications and often to death. From this engrossing study has developed the modern doctrine of focal infections which is attracting the attention of present day investigators. The study of the methods by which purification of the blood is effected presents a promising field for investigation.

The paramount importance of the hepatic function. The liver was recognized, even by the ancients, as the king of organs, standing as a buffer on the one hand, between the general circulatory system and the gastrointestinal tract, and, on the other hand, between the general circulation and the spleen, which filters from the blood micro-organisms and toxins that it is unable to destroy, sending them to the liver through the portal circulation for destruction and detoxication. The liver detoxicates chemic poisons, such as chloroform, phosphorus, and arsenic as well as biochemic poisons produced in the body. Yet, for many reasons, we know little concerning the functions or early pathologi-

cal conditions of the liver. Its concealed situation prevents us from accurate means from without of early diagnosis. Its power to regenerate injured cells and form new cells, is not equalled by any other organ of the body, and its enormous margin of safety prevents us from knowing just what is taking place in the earlier stages of hepatic disease, and the appalling nature of the pathological changes when they are sufficient to enable physical demonstration has made the liver an organ of mystery and conjecture. I venture to predict that the next few years will bring forth productive research demonstrating that the causes of many of the changes in the so-called vital organs which lead to death do not primarily originate in the nervous system, heart, lungs or kidneys, but are the results of hepatic insufficiency, leading to inefficient purification of the blood, thus making possible much sound prophylaxis.

I have, on a previous occasion, discussed the function and pathology of the liver in relation to the hepatic cell. All the liver cells are alike. Therefore, the pathological architecture in hepatic disease is simple. If the pathological process in the hepatic cell is acute the destructive process assumes the nature of fatty metamorphosis. If the process is chronic, the destroyed cells are replaced by connective tissue, producing cirrhosis. If the cause of the hepatic cirrhosis is carried to the liver by the portal circulation, the new connective-tissue deposit is around the portal vessels, obstructing the delivery of the blood from the portal circulation to the hepatic cells, and the patient does not die from hepatic insufficiency, but from the circulatory disturbances which lead to ascites and gastro-intestinal hæmorrhages caused by the portal cirrhosis. On the contrary, in biliary cirrhosis the causes of the injury to the hepatic cell are brought by the biliary channels, and the connective-tissue deposits are around the bile ducts, resulting in obstructions to the flow of bile, so that death occurs from cholæmia in cases of biliary cirrhosis.

In connection with hepatic cirrhoses, passing attention should be given to the work of Herrick, who shows the effect of the hepatic artery on the cirrhotic process. The pressure in the portal vein is 30 millimeters, and the pressure in the artery 130 millimeters. The greater the obstruction to the portal circulation the greater the circulatory embarrassment occasioned by the arterial counter-pressure. The slight amount of oxygen needed by the hepatic cell for its own purposes is furnished by the hepatic artery. It is interesting to note, in connection with carbohydrate metabolism, that in the liver of carnivorous animals the ligation of the hepatic artery may not cause serious effects, while in the herbivorous, it usually causes death.

The liver acts on nonoxygenized blood. The hepatic cell has an unrivalled capacity to act on portal blood, which has already lost its oxygen. The blood on which the liver acts is venous and leaves the liver as venous blood through the hepatic veins; oxygen plays little if any part in the changes which take place. Physiologists point out that the hepatic artery furnishes oxygen to the liver, and this would appear to be true, so far as the liver tissue is concerned, but the supply is not sufficient to lead us to believe that oxygen is necessary to its function. Compare the arterial blood supply of the liver, weighing 50 to 55 ounces, with the huge arterial blood supply of the spleen and kidney, each of which weighs only a few ounces, but uses a great amount of oxygen in functioning. The hepatic artery is not large and its content is reduced greatly by giving off the gastroduodenal artery, the superior pyloric artery, the supraduodenal branches, and the cystic artery; thus two-thirds of its volume are gone before it reaches the liver. How can we know the truth of this assertion that oxygen is not necessary for liver function? By proving an alibi: The arterial blood of the hepatic artery can not be in two places at the same time and most of it goes to other organs. Possibly one of the functions of the spleen is the removal of oxygen from the blood which enters the liver by this route. The functions of the liver are: (1) defense against invasion of the body by micro-organisms and the detoxication of toxic products brought to the liver from the portal circulation, (2) fat metabolism, (3) protein metabolism, (4) carbohydrate metabolism, and (5) bile function.

I cannot discuss here the fascinating problem of the effect of the liver on bacteria and toxic products of a chemic and biochemic nature. With regard to the effect of the liver on the final conversion of proteids into consumable material, I would point out that the amino-acids in the body are developed in the liver from protein metabolism begun in the intestinal tract. It may also be stated that the liver is one of the great store houses for fat, and the convertor of fat into consumable material for the use of the body. Urea is the ash of protein burning, and certain higher fatty acids, which may be a residue of improperly oxidized fats in combination with ash of improper proteid burning, are back of many of the circulatory and vascular changes which lead to insufficiency of the vital organs, especially of the kidneys.

Sugar-forming function of the liver. I regret that many aspects of these various problems, although germane to this discussion, must be omitted for lack of time. I shall concentrate attention on the relation of carbohydrate metabolism and bile function, on the liver, and on the organism as a whole.

The end stages of carbohydrate metabolism take place in the liver and the distribution of sugar for the heat and energy of the body takes place through the blood stream. The amount of sugar normally in the blood varies between 0.07 and 0.11 per cent. The ash of sugar oxidation in the tissues is passed out of the body through the lungs as carbon dioxide. Normally, considerable amounts of glycogen are stored in the liver and this store under great stress is fed more liberally into the blood stream, and in conjunction with the internal secretions gives the utmost obtainable energy under the influence of anger or fear, acting through the autonomic nervous system. In starvation the stored-up glycogen is exhausted and the alkalinity of the blood reduced, so-called acidosis. The pernicious vomiting of pregnancy is believed by Harding to be due to the exhaustion of the stored liver glycogen by the constitutional necessities of the mother and child; the treatment of pernicious vomiting of pregnancy by carbohydrate feeding appears to bear out this theory. As a rule reduction of sugar below 0.07 per cent is accompanied by dehydration. In the estimation of the blood sugar, which may appear to be normal because of the increased blood viscosity, allowance must be made for sufficient fluids to approximate normal conditions.

The ash of carbohydrate oxidation is much less poisonous than the ash of protein and fat combustion to which diabetic coma is due. As shown by Woodyatt, the proper burning of protein and the higher fatty acids is not complete unless a percentage of carbohydrates is burned in conjunction; hence the value of starvation in the management of diabetes by reducing fats and proteins as well as carbohydrates over the old treatment by carbohydrate deprivation alone. Attention must not be diverted from the fact that the hepatic cells are working on portal blood with very low oxygen content, herein differing from all other secretory organs of the body. Too little attention has been directed, I believe, to this nonoxygen feature of the function of the liver. Chronic bodily exhaustion is associated with disturbed function of the liver and usually with diminution of sugar metabolism. Mann has shown that if the liver of an animal is removed, death results in from 5 to 12 hours, but if the blood sugar is maintained the animal will live for from 24 to 35 hours, and even when apparently moribund can be resuscitated by intravenous injections of glucose.

Function of the bile. The hepatic lobule has for its center a bile channel. The venous blood from the portal circulation is acted on by the hepatic cell and passes away in the venous plexus of the collecting hepatic veins; the refuse, if it may be so called, takes it away to the intestinal tract in the form of bile. Nature is most economical in her operations. The bile in the intestinal tract has valuable direct and indirect functions, aiding in pancreatic and intestinal digestion. The fluids and certain constituents, such as the lipoids, are reabsorbed in the intestinal tract, while the bile pigments which contain the more active poisons of the biliary content pass and are excreted. It is interesting to note in this connection that the bile does not give the normal brown color to the stool, which may be

light and pasty without the addition of pancreatic juice. Physicially the bile is changed after it leaves the hepatic cell. Additions are made to it from the biliary ducts and such bile as reaches the gall-gladder, as shown by Rous and McMasters, is concentrated and clear fluid added. If the bile is retained for any length of time in the gall-bladder by an obstructed cystic duct, the biliary pigments are absorbed and a clear colloid fluid, so-called white bile, results, as is also the case with bile in the ducts of the liver under similar conditions. The effects of retained bile pigments on the obstructed hepatic cell are most deleterious and destructive, the process being the familiar one of fatty metamorphosis, connective tissue taking the place of many of the destroyed cells, although new hepatic cells may be developed. Fitz has examined many specimens of bile from the gall-bladder under various conditions; the results of these chemical analyses were, on the whole, disappointing. When the bile is obstructed in its passage into the intestinal tract it is absorbed in the blood, the biliary pigments unite with the calcium in the blood, and, in the course of time, 3 weeks or more, a calcium exhaustion may occur. The reduction of the calcium reserve in the blood lengthens the coagulation time. The bile pigments, to which much of the ill effects of cholæmia are due, are excreted from the blood by the kidneys. The cholæmia not only affects the liver, but the tissues of the body as a whole. Cholæmia brings about a pernicious dehydration, interferes with the action of the liver, especially in its sugar-forming function, and exhausts the hepatic sugar reserve. The secondary effects of cholæmia are felt by every organ of the body, especially by the kidneys, which are called on to excrete a great amount of bile pigments and other products of disturbed metabolism which may result in kidney incompetency as well as liver insufficiency. In many respects the urine function of the kidney and the bile function of the liver are comparable. Especially is this true under stress. There is a close connection with diseases of the skin, liver, and kidneys, as though there were a correlation of function, notably the production of acute nephritis in the exanthemas and the poisonous bile of extensive burns of the skin which results in fatal duodenal ulceration.

OVERCOMING THE EVILS OF CHOLÆMIA

The practical questions connected with cholæmia in its relation to surgery are obvious, and the successful solution of these problems carries lessons which can be applied to various other forms of hepatic incompetence. Bell and Walters, of the Clinic, have investigated cases of chronic jaundice in which operation had been performed for any and all conditions and death followed. Fifty-three per cent of these patients had blood in the peritoneal cavity, although not necessarily enough to account for the death. In comparable cases in which no jaundice was present there was only one instance of intraperitoneal hæmorrhage, which was caused by the slipping of a ligature on the cystic artery. In the jaundiced patients the blood in the peritoneal cavity was from capillary hæmorrhage; in no instance was the bleeding from demonstrable vessels.

Wright has pointed out that the loss of normal coagulation of the blood is due to calcium exhaustion and that the calcium can be restored by giving chloride of calcium by way of the gastro-intestinal tract. Lee and Vincent have shown that the amount of calcium that can be taken up from the gastro-intestinal tract is relatively small, but it may readily be given in the form of chloride of calcium intravenously in which form it affects the blood coagulation in a short time. Walters has been able to show that the coagulation time can be restored in from 2 to 6 hours after the intravenous injection of chloride of calcium and that the procedure is harmless. He repeated the experiments of other observers and it was not only shown that the administration of calcium promptly restored the blood coagulability due to calcium exhaustion, but that the coagulability of normal blood could be hastened in this manner.

In the cholæmic state, however, calcium may not be the only factor in the tendency to bleed, and when the calcium exhaustion has been remedied, if the coagulation time is still high, transfusion of blood is indicated. Two other factors of importance must be consid-

ered in counteracting the evil effects of the cholæmic state; first, to restore the normal amount of blood sugar and liver glycogen reserve, and second, to overcome the dehydration, and thus aid the kidney in the elimination of bile pigments, which are one of the chief causes of the general exhaustion of the cholæmic patient. Fortunately this can be accomplished by increasing the quantity of ingested carbohydrate and fluid intake, by mouth, by the Murphy drip, or if necessary, by subcutaneous infusions of from 3 to 5 per cent solution of glucose which can be introduced subcutaneously up to 2,000 or 3,000 cubic centimeters in 24 hours. The surgical indications are most safely met by great care and gentleness in handling the tissues of cholæmic patients during operation. No operative procedure which is not essential to the immediate recovery of the patient should be undertaken in the presence of intense jaundice. For example, after removing stones from the common duct in the cholæmic patient, cholecystectomy is seldom advisable.

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THE TECHNIQUE OF GALL-BLADDER SURGERY IN THE PRESENCE OF JAUNDICE[1]

By GEORGE W. CRILE, M.D., F.A.C.S., Cleveland, Ohio

IN jaundiced patients demanding operation, one prime risk is encountered, i.e., *exhaustion*.

The liver is a vital organ—as necessary to the maintenance of life as the brain or the heart. Excision of the liver is followed by an immediate functional and physical impairment of the brain cells, rapidly progressive to their complete breakdown with resultant death within from 2 to 12 hours. Moreover, any impairment in the integrity of the liver is accompanied by a corresponding impairment of the brain cells. Therefore, if as the result of obstruction of the common bile-duct, the liver has become engorged and distended with bile, and its function has become depressed, to a corresponding degree will the functioning power of the brain and other vital organs be reduced.

It follows that when operation is required in the presence of jaundice and depression, the failing resources of the patient, that is, the remnant of the liver function, must be scrupulously preserved; and, if possible, the margin of safety increased. In these cases the internal respiration is seriously impaired.

The prime requisite, therefore, to the conservation of the patient is the conservation of the internal respiration, especially the internal respiration of the liver cells and of the brain cells. The conservation of the internal respiration of the cells depends upon three primary factors: oxygenation, water, and neutralization of excessive acids.

All inhalation anæsthetics—even nitrous oxide—interfere with the internal respiration. In the case of nitrous oxide the interference with the internal respiration is but temporary—only during the period of administration. In the case of ether and chloroform, on the other hand, on account of their lipoid solvent effect upon the cell structure, their interference with the internal respiration is prolonged. The point of vital importance in this connection, and I believe the source of common error, is this: inhalation anæsthesia inflicts on the cells a definite functional damage. The mere fact that the patient comes out from under the influence of the anæsthetic does not eradicate the handicap produced by the anæsthetic. The inhalation anæsthetic deprives the patient of from 10, 20, 30, 50 to 100 per cent of his chance of ultimate recovery.

The internal respiration is depressed by cooling; it is promoted by heat. The continuous uncontrollable fall of the temperature of the brain following excision of the liver is equaled by the fall of the temperature of the brain during surgical anæsthesia under ether. Under nitrous oxide-oxygen anæsthesia the fall of the temperature of the brain is but slight, and under analgesia it is negligible.

It was the truth of these considerations, reluctantly accepted, that led me to substitute for deep inhalation anæsthesia, an extremely light form of nitrous oxide anæsthesia, namely, analgesia. Analgesia gives freedom from fear, worry, or anxiety; it mitigates the sense of pain about 80 per cent, and the balance can be covered by local anæsthesia. But the attribute of analgesia which is of vital importance to the patient is that it does not perceptibly interfere with the internal respiration.

[1] Read before the Clinical Congress of American College of Surgeons, Philadelphia, October, 24–28, 1921.

As a result of the experience of the Great War, together with the findings of certain researches, an all-important principle has been introduced into the surgery of the bad-risk patient. The management and treatment is based on *probability* and not on the state of the patient at the moment. This conception is comparable to the principle of preventive medicine; that is, in the case of the bad risk patient we do *in advance of the emergency* all that we would do should the emergency develop. In preventive surgery as in preventive medicine, we can never know whether or not the preventive measures were required in the individual case; we only know that the emergency did not happen. Anociation, like asepsis, is an example of preventive medicine.

In cases of jaundice the failing vigor of the liver cells, and indirectly the vigor of the cells of other vital organs, is conserved and increased in accordance with the basic principles we have described above.

The function of the liver is depressed by narcotics, especially morphine. Therefore narcotics are contra-indicated in the presence of an already depressed liver function, both before and after operation. In these cases the damaging effects of emotion and of pain must be controlled as far as possible by management and by inflicting a minimum amount of trauma.

As stated above, cooling specifically depresses the liver function; therefore the exposure should be as slight and as brief as possible, and hot packs should be applied immediately after operation.

Blood transfusion promotes the oxygenation of the cells, and saline infusion aids in maintaining the water equilibrium and the acid alkali balance; therefore blood transfusion and large saline infusions should be employed either before or after operation. Their influence is not striking. No measure will produce a striking improvement; but a slight gain may establish the outcome, and the patient should have the benefit of even the small advantage which may mean the difference between life and death.

In grave cases, the operation should, if possible, be divided into two distinct physiological stages. The first stage should include only such measures as are requ'red for the relief of the biliary obstruction, wholly disregarding any maneuver for the removal of the stones unless they are in the way. If the gall-bladder is distended, it should be drained by a fluid tight system, decompressing it slowly by intermittently unclamping the rubber drain.

The ultimate operation can well be delayed until the danger point is passed, and the stability of the liver cells and of the brain cells has become established.

As to the operative technique in jaundiced cases, we are committed to ample exposure, that is, to a long incision; but if the gall-bladder is distended, a short incision, for merely establishing drainage, may be all that is required, especially in aged patients with large gall-bladders which are easily defined prior to operation. A very short incision immediately over the gall-bladder for the insertion of the drainage tube may be so conducted as to become almost a minor operation. On the other hand, in broad-chested, fat patients, jaundiced as the result of obstruction from common duct stones, the Bevan or the Kocher incision may give a better exposure than a vertical right rectus.

In cases of common duct stones associated with chills, prostration, etc., in which the gall-bladder offers an avenue of temporary relief by drainage, the operation is divided into two parts, the first consisting of gall-bladder drainage only, followed later by a curative operation on the common duct.

If forced to operate in the midst of chills, prostration, etc., in a jaundiced case in which the gall-bladder is usually a shrunken mass of scar tissue containing no bile, while the common duct is dilated, the common duct is dealt with as follows: With a syringe, much of the bile is drawn off; in part to prevent contamination of the field when the duct is opened, in part to determine the kind of bile, the presence of pus, etc. The common duct is then opened and the stones in the immediate field removed, but no difficult and prolonged search is made, not even a prolonged effort to dislodge a stone in the duodenal part of the duct; but drainage—rubber tube drainage—sewed in to make a fluid tight connection with the common duct, completes

the technique. An abundance of drainage is placed around the point of common duct drainage and a generous portion of the incision in the abdominal wall is left open to ensure a safe drainage.

At the conclusion of an operation in which the entire biliary tract is not clearly defined and explored by the usual common and hepatic duct instrumentation, associated with the usual manipulation and palpation—that is, an operation completed without definite knowledge as to the number and location of stones—the surgeon has an uncomfortable feeling of suspended judgment, but he has his patient, who may be cured on another and more auspicious day.

The postoperative treatment has already been indicated. Briefly the main features are:

1. Hot packs over the entire liver region applied immediately after operation and continued intermittently until convalescence is securely established.

2. The subcutaneous injection of 3000 to 5000 cubic centimeters of water—repeated if required.

3. One or more transfusions of blood during the first week.

4. Avoidance of narcotics, especially morphine.

5. Intermittent drainage of bile. If it is noted that the bile is becoming more scanty in amount and paler in color the prognosis becomes correspondingly more grave. In my personal series of 629 operations on the gall-bladder and ducts, I have seen one case in which the bile was milky white in color. This patient died.

SUMMARY

Before operation employ saline infusion, blood transfusion and heat.

At operation employ analgesia, local anæsthesia, means to maintain temperature of liver, decompression of bile, nothing more.

After operation employ blood transfusion; saline infusion, 3,000 to 4,000 cubic centimeters; application of heat to liver; intermittent drainage of bile.

Avoid deep inhalation anæsthesia, needless handling, morphine, doing too much. Decompress and no more.

An examination of the histories of 870 gall-bladder cases in the Lakeside Clinic shows the presence of jaundice noted in 389, or 44.7 per cent.

FACIAL PARALYSIS

By ALEXANDER GIBSON, M.A., M.B., Ch.B., F.R.C.S. (Eng.), F.R.S.E., F.A.C.S., Winnipeg, Manitoba

FACIAL paralysis is a distressing condition which may be due to a number of very different causes. According to the nature and the site of the lesion, its outlook may be bright or gloomy. While the condition is present, it is always an unpleasant one. Of the associated symptoms one of the most weighty is the question of personal appearance. This consideration is universal in its appeal, and rightly so. Indeed, the psychic effect of the condition usually outweighs the physical. The patient is conscious that his appearance is not what it ought to be, and he is deprived of the power of expressing his personality by the modification of his facial muscles; his emotions are but half revealed, and he has always the feeling that the individua addressed regards him with a certain amount of pity or it may be of disparagement. Further, he is handicapped alongside his fellows in any activity, commercial or social, where personal appearance is of importance. Added to these the e are certain physical drawbacks. These group themselves naturally into those associated with the eye, t e brow, the mouth. Of oral disabilities, inability to control the lips permits of fluid escaping unless the head be tilted. The laxity of the cheek allows food to collect between the teeth and the lips. However, much he may wish to give expression to the *joie de vivre* he cannot do so by whistling, and in certain circles his prestige may be lowered by the inaccuracy of his aim in expectoration (20). Again, since it is impossible to control the lips accurately, the labial consonants cannot be formed with precision and clear enunciation is interfered with.

Inability to close the eye causes considerable discomfort in windy or dusty weather, while the lack of tone of the lower eyelid causes the puncta lacrimalis to point forward, hindering the drainage of the lacrimal secre ion.

On all counts, therefore, one cannot but consider facial paralysis as a serious disability.

The actual gravity of the condition varies with the cause and the site. Interference with the nerve fibers corresponding to the face musculature anywhere between the lowest part of the motor cortex and their ultimate distribution will cause paralysis. Thus the upper neurone may be damaged by a cortical tumor or a cerebral hæmorrhage into the internal capsule. In such cases the facial paralysis would be but an incident in the main lesion. Usually lesions of the upper neurone are referred to as "cerebral" or "supranuclear" paralysis. Cases of this sort—seen typically in the hemiplegic—are characterized by the lower part of the face being chiefly affected. Lesions of the facial nucleus itself are usually spoken of as "nuclear" lesions, and of the nerve path below this level as "infranuclear" lesions. In nuclear and infranuclear lesions, the upper and lower parts of the face are as a rule equally involved.

The course of the nerve, though somewhat complicated, is such that it is comparatively easy to diagnose the exact part of it which is involved. The nucleus is situated in the pons, just external to the sixth nucleus. From here the fibers winding around the sixth nucleus, pass to the lower border of the pons, emerging with the eighth or acoustic nerve between the olive and the restiform body. From its exit from the pons to its entrance into the internal auditory meatus, the seventh and eighth nerves are intimately in contact. After entering the internal auditory meatus, the nerve traverses the aqueduct of Fallopius, having placed upon it the genicular ganglion and giving off the nerve to the stapedius as well as being joined by the chorda tympani carrying taste fibers from the anterior two-thirds of the tongue and secretory fibers to that region. From the petrous temporal bone the nerve emerges through the stylomastoid foramen, passes after a short course into the parotid gland, and after forming the pes anserinus breaks

up into several groups of branches. It is unnecessary for practical purposes to mention the facial muscles in detail. It should not be forgotten that the facial nerve is in reality a mixed nerve conveying not only motor fibers but sensory ones. The ganglion which is analogous to a posterior root ganglion is situated on the nerve a short distance after its entrance into the petrous bone. The sensory characteristics of the nerve need not detain us; they have been carefully studied by Ramsay Hunt.

A peripheral lesion may affect the nerve (a) at the nucleus, (b) between this and its emergence from the pons, (c) between this point and its entrance to the aqueduct, (d) in the aqueduct, (e) after separation of the chorda tympani to join the lingual. The vicinity of the sixth nucleus and nerve make it usually easy to locate a lesion in parts (a) and (b). In addition it is here usually associated with "crossed paralysis." In the third part of the course of the facial, the eighth nerve is frequently involved, and if the latter be not involved, paralysis of the fibers to the stapedius muscle produces the extreme sensitiveness to loud sounds known as "hyperacusis." In the aqueduct itself, involvement of the fibers of the chorda tympani produces loss of taste sensation in the anterior two-thirds of the tongue. A lesion of the fifth part of the nerve shows the typical complete motor paralysis (Bell's palsy); there is no interference with taste and no hyperacusis.

ETIOLOGY

Among the causes of facial paralysis, the majority are well defined, a few are obscure. A supranuclear paralysis may be produced by a tumor, by an abscess, or by a cerebral hæmorrhage. An isolated nuclear paralysis is strongly suggestive of syphilis. In epidemics of poliomyelitis the cranial nerves may show involvement. Thus, in 338 cases at Queensboro hospital during the 1916 epidemic in New York, 46 showed involvement of the cranial nerves; of which 26 were of the facial nucleus and 12 of the sixth nucleus. Diphtheria may also be followed by facial paralysis. Cases of infranuclear paralysis are relatively more common. In the pons they are usually associated with tumor or hæmorrhage. Tumors of the cerebellopontine angle frequently involve both seventh and eighth nerves. Facial paralysis may appear as an incident in brain injuries. Of 195 cases of brain injury recorded by Sharpe, 3 showed facial paralysis. Two of them were associated with fracture of the skull. In both of these the paralysis was regarded as "due to a mild œdematous compression of the facial nerve at the usual site, the aqueduct of Fallopius." The third case was not associated with fracture of the skull. Steadily increasing intracranial tension was taken as an indication for decompression; at the operation the brain was observed to be "wet" and œdematous. The paralysis was of the cortical type and was regarded as due to "an acute cortical œdema following the injury; the almost immediate recovery from this facial weakness after the operation of decompression and drainage would also confirm the diagnosis of acute cortical œdema—at least of the left cerebral cortex."

The three commonest causes of facial paralysis, however, are those which affect the nerve in the outer part of the facial canal or after its emergence from the skull. These are:

1. A simple neuritis commonly the result of exposure to cold, especially when the patient has become heated from exertion. Thus one patient, after a strenuous day of golf in the heat of summer, drove several miles in an open car in the cool of the evening and awoke next morning with a unilateral facial paralysis.

2. Spontaneous occurrence is possible in the course of acute or chronic otitis media; this is more marked in children. This matter is discussed by Barton Jones, who regards facial paralysis in connection with otitis media as of infrequent occurrence. When it does occur it is brought about either by direct involvement of the nerve or by pressure of exudation within the fallopian aqueduct or by pressure from the tympanum. Caries of the wall may take place even in the acute stage. The facial nerve has sometimes been found postmortem lying free in the tympanic

cavity surrounded by pus, and yet no symptoms of facial paralysis may have been observed during life. From this he concludes that it might reasonably be inferred that to produce facial paralysis pressure must be applied to the nerve while the latter is confined within its narrow bony tunnel. The paralysis may come on suddenly or gradually; certain muscles may be affected more than others, severe pain may precede its development, or muscular twitchings may occur.

3. Traumatism, surgical or otherwise, may produce facial paralysis. In the complete mastoid operation, the breaking down of the "bridge of bone" between the antrum and the middle ear is a possible source of danger to the facial nerve. The great majority of cases come from this source. In children, owing to the small development of the mastoid process, the facial nerve is almost superficial, and special care is necessary even in such a simple operation as drainage of the antrum. Again in children systematic and thorough removal of enlarged glands of the neck is fraught with danger. One of my cases showed no obvious cause for the condition. It was probably due to a sclerosing process about the internal auditory meatus involving both seventh and eighth nerves. Another case was inevitable as a result of extirpation of the cochlea. Still another case was the result of a rifle bullet wound which severed the facial nerve cleanly just after its exit from the stylomastoid foramen.

Bilateral facial paralysis is not a very common condition. De Castro maintained that of such cases, 95 per cent are of syphilitic origin. This, however, is not generally accepted. Askgaard quotes a case where syphilis was to his mind out of the question, and is strongly of the opinion that in most cases the origin is "rheumatic." He is no more prepared, however, than anyone else to fix a precise connotation for the word "rheumatic."

PROGNOSIS

The prognosis depends essentially upon the site of the lesion and its character. Cases affecting the upper neurone are not likely to show spontaneous recovery. The majority of cases of facial paralysis met with do clear up, because the bulk of them are cases of simple neuritis associated with exposure. In the case of injury to the nerve resulting from operation, no recovery is to be looked for if there has been actual severance of the nerve fibers, and it is hard to see how recovery can take place, where paralysis is a sequel to operation, except in the cases where a localized œdema of the nerve is a result of reactive processes in the neighborhood. Outside the skull, the prognosis is not so good. The nerve very soon breaks up into branches, and judging from one's experience in nerve suture, the outlook is rather unfavorable when a large number of branches pass off near the point of damage. Broadly speaking, therefore, it may be said that when paralysis comes on suddenly and completely after a mastoid operation and does not clear up in 5 or 6 weeks, there is not likely to be spontaneous recovery. It is of some value in all cases to test the electrical reactions. In cases of complete severance the reaction of degeneration appears in about 2 weeks. The presence of a response to faradism is always a hopeful sign. Those who have a good deal to do with electrical reactions in nerve lesions incline to place less stress upon mere qualitative response. Without a condenser to give quantitative measurements, electrical tests are of limited value, and the condenser is an instrument not always available.

TREATMENT

This depends upon the cause. Where the facial paralysis is but an incident in a more serious affection, as in hemiplegia, one's conduct of the case must be governed by general considerations. The only case of facial paralysis in poliomyelitis which I have observed made a spontaneous recovery in regard to the facial nucleus in about 6 weeks. Cases of facial neuritis (Bell's palsy) generally recover in a time varying from a few days to a few months. We are accustomed to treat these cases by massage of the facial muscles and by galvanism. It is doubtful if these measures are of much value. They are of some psychic use at least, comforting surgeon and patient alike with the feeling that "something is being done."

The large group of cases where facial paralysis, complete and permanent, is the main entity deserve special consideration. Where this follows directly upon operation for mastoid disease, there is a double demand from patient and operator that an effort be made to remedy the defect. The otologist is usually distressed, this being as a rule the only case he has ever had in a vast experience of the operation, and the liveliness of the patient's gratitude for relief from the ear condition is much diminished by the prospect of going through life with one side of his face an immobile mask.

One always feels in such cases that an attempt to improve the condition is a pressing surgical duty. The stake the patient lays is not a very heavy one; even if he loses it and gains nothing, he is not a very heavy loser, while if he does gain, the gain is considerable.

Operative methods fall into two groups: (a) those which assume the nerve defect to be irremediable and attempt by transplantation of muscle, fascia, etc., to remedy the main disadvantages due to defective musculature; and (b) those which attempt to innervate all the facial muscles by means of nerve anastomosis.

Before discussing the relative merits of these two points of view it is well to remind ourselves of the main effects of facial paralysis. The facial muscles may be grouped in three sets: (1) those which act upon the angle of the mouth, especially those which elevate it; (2) those which act upon the eyelids, especially the lower, elevating the latter and thus assisting in closure of the eye; (3) those which act upon the forehead, enabling the brow to be wrinkled and the eyebrow raised. All of these actions are not of equal value, nor are they equally valued by all patients. On the average we might place the elevation of the angle of the mouth at 50 per cent to 60 per cent, the elevation of the lower eyelid at about 30 per cent to 40 per cent, and the action on the forehead and eyebrow as not more than 10 per cent.

The plastic operations which are performed have, as one would expect, two designs, (a) to elevate the lower eyelid; and (b) to elevate the angle of the mouth. Elevation of the lower eyelid may be attempted by raising a pedunculated flap from the temporal muscle anterior border. This is sutured along the lower lid to the orbicularis palpebrarum (Lexer). Efforts to raise the angle of the mouth have also been made by a strip of free fascia (Stein), by a graft from the masseter or the sternomastoid, (Jianu) or by the insertion of aluminum-bronze wire so as to sling the upper lip from the zygomatic arch (Busch Momberg).

Published reports indicate that there may be a place in surgery for operations with such an aim, but if by nerve anastomosis a prospect is afforded of more equal innervation of muscles, such an operation has a logical priority. The plastic operation involves a scar which is apt to be clearly visible. Speaking without any experience of any of them, one feels that they are more ingenious than trustworthy. The further criticism is applicable that they are more suitable when one branch of the facial nerve has been injured or after an attempt at nerve anastomosis has definitely failed.

Study of the literature would convey the impression that there remains very little more to be said to convince the surgeon of the practical utility of the operation of nerve anastomosis. Information on the subject is not yet, however, universally shared, as would appear from a recent publication (1919) "prepared at the suggestion of the Subsection on Plastic and Oral Surgery connected with the office of the Surgeon-General." It says: "When the facial nerve has been divided external to its exit from the petrous bone, causing facial paralysis, anastomosis with the central end of the spiral (?) accessory nerve or the hypoglossal nerve is an approved operation. Such anastomosis, however, is impracticable if the injury to the facial nerve has occurred within the aqueduct of the petrous bone." In the succeeding paragraph the suggestion is made that "Perhaps a nerve graft from sciatic nerve might be used to repair facial nerve." (What would happen to an undergraduate who put that sort of thing in an examination paper?)

A new impetus has been given to the subject of nerve anastomosis by the enormous number

of cases of nerve suture resulting from the war. Personal experience of nearly two hundred cases of nerve suture, although it has not enabled one to speak with confidence regarding the result in any individual case, justifies the opinion that provided careful end-to-end anastomosis is obtained without tension, the majority of cases will give at least some recovery of function. The ingenious methods of lateral implantation and of nerve grafting have been clinically uniform failures; the two points mentioned are the essentials—neat apposition and no tension. It is possible to obtain these requisites in the case of the facial nerve. In moderately close proximity are found the hypoglossal and the spinal accessory, and each of these is fairly similar in size to the facial nerve.

In 1903, Ballance recorded his experience up to date. His first case was done in 1895, the spinal accessory being cut half through and the facial sutured into the cleft with fine silk.

In 1898, Faure united the trunk of the facial nerve to the trapezius branch of the spinal accessory by end-to-end suture. The result was not good. In 1899, Kennedy performed end-to-side anastomosis of the facial and accessory for facial spasm. In 1900, Manasse reported a case in which he did an end-to-side anastomosis between facial and accessory. In 1901, a similar case was put on record by Barrago-Ciarella. By 1903 Ballance was able to report that 5 patients out of 6 showed voluntary movement, the previous paralysis having lasted from 5 months to 3 years. He further claimed that after operation facial muscles which had shown contracture immediately became flaccid again, and that tonus returned rapidly to the muscles so that at rest the face became symmetrical. Motor power was also observed to return before faradic excitability. There was, however, in no case independent movement of the face unassociated with shoulder movement. He was prepared to recommend in future faciohypoglossal anastomosis. The first actual faciohypoglossal anastomosis was performed by Koerte in 1901. The first patient so operated on by Ballance was treated in 1902. In 1903, Harvey Cushing recorded a case of facio-accessory anastomosis similar to those of Ballance. Practically the same degree of success which he had attained was reached by Cushing's patient. In 1903, also Frazier and Spiller published a "preliminary report on one case." This was a faciohypoglossal anastomosis in a case of gunshot wound with complete paralysis. They recognized three stages of improvement: (1) restoration of normal muscle tone which in itself would warrant the operation; (2) voluntary control over individual muscles; (3) complete and perfect recovery, i.e., the return of expressional movements, etc. They concluded that the first can ordinarily be expected, the second is "liable to follow," the third would be more likely the younger the patient. In 1908, a number of cases were put on record. Girard reported 4 cases of facio-accessory anastomosis; Knapp, 3 cases of faciohypoglossal anastomosis; Currie reported from South Africa a case of anastomosis between the seventh and eleventh nerves. Halstead proposed the modification of reflecting the mastoid process along with the origin of the sternomastoid, a procedure which is sometimes of use to give a larger field for tracing the facial nerve to the stylomastoid foramen. In 1909 Ballance again contributed a paper on the subject. He described a case in which after anastomosing the facial to the hypoglossal he joined the distal segment of the twelfth nerve to the eleventh. He showed the case at the German society of surgeons in Berlin, and at the same meeting Tilmann, of Cologne, showed "a very successful case of faciohypoglossal anastomosis" 4 years after operation. Ballance summed up strongly in favor of the twelfth as against the eleventh nerve for use in anastomosis. "Experience has shown that the atrophy of one-half of the tongue leads to no material inconvenience, but loss of power in sternomastoid and trapezius muscles may be associated with deformity, discomfort, inconvenience and even worse results." He further claimed that "the movements" in his case "due to emotional stimuli are symmetrical and perfect." This is an unusually good result. In 1909, also a paper appeared by Beck giving a very good résumé of the litera-

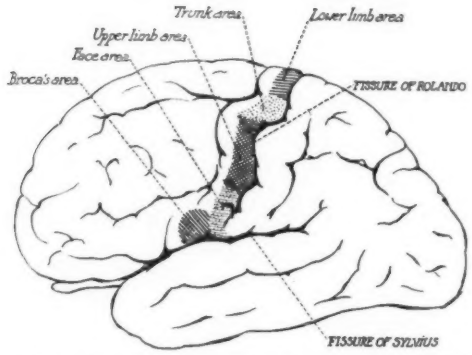

Fig. 1. Cerebral cortex showing motor areas and speech center. (Modified from Cunningham.)

ture up to date, and an account of 5 cases operated upon by himself by faciohypoglossal anastomosis with promising results. He emphasized the large number of cases which result from suppurative otitis or trauma of the nerve in operations on the temporal bone. In this year also, Alt, of Vienna, described a method of opening the facial canal directly, blanching the tissues with adrenalin as he went, and relieving compression on the nerve. As far as can be made out, this method has not been developed any further. An interesting case was reported by Grant in 1910. The patient suffered from a pistol wound of the right ear. Grant stitched the facial to the accessory, and then united to the stump of the accessory the descendens hypoglossi. Six months later the patient could play the flute. In commenting on the case he says: "The descendens hypoglossi is a little smaller than the accessory but that is not an important objection. The accessory is a little smaller than the facial but that is no disadvanage in facial anastomosis." In 1911, a paper appeared by Rothschild, reviewing 188 reports on the subject and giving details of 68 cases, 10 from American literature. The remote results were given in 46 cases. Of these 8 cases showed "complete restitution," the majority of the results were fair, and only one case was a complete failure. With this rosy pronouncement it is of interest to learn from the paper of Zesas in 1914, that in 73 cases of chronic facial paralysis which he had compiled and which had submitted to nerve

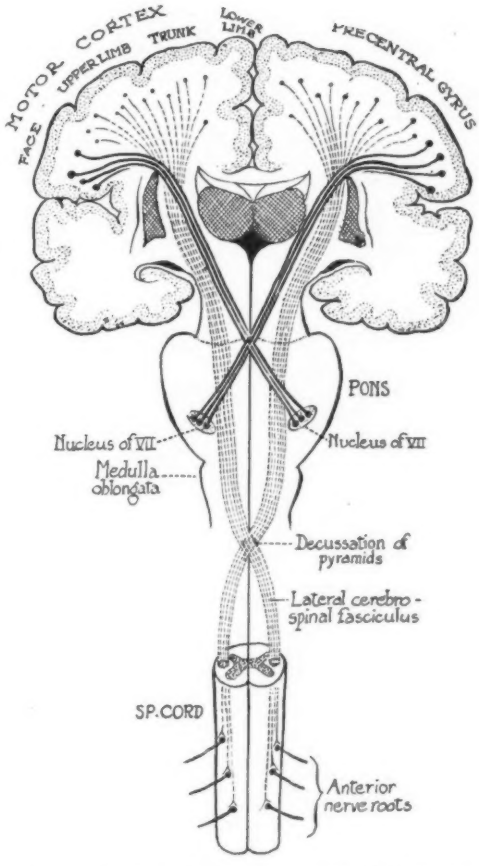

Fig. 2. Diagram of relations of upper facial neurone. (Modified from Gray.)

anastomosis, the results were disappointing; no benefit was received in over half the cases. Even in cases regarded as successful, the improvement was meagre, and there were numerous annoying by-effects. He thought much better results were to be obtained by plastic operation on muscles such as those of Gomoiu and Jianu, of Lexer and Hildebrand. He then described the technique of Busch's wire-loop and Stein's fascia-flap methods. One cannot but think that Zesas when he studied the subject of nerve anastomosis was not in a judicial frame of mind.

It is unnecessary to pursue in detail the later reports on the subject. Nothing sub-

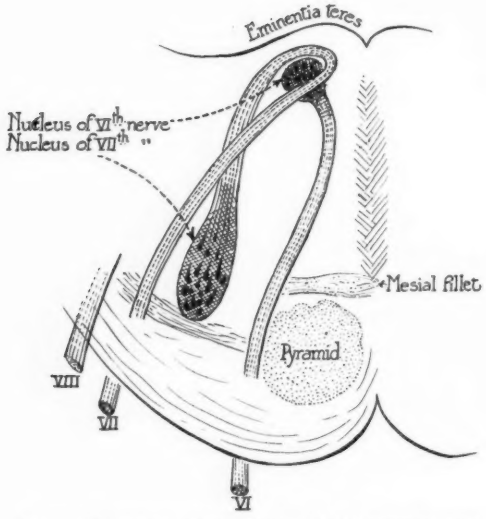

Fig. 3. Diagram to show relation of facial nerve to sixth and eighth. Region of pons. (Modified from Cunningham.)

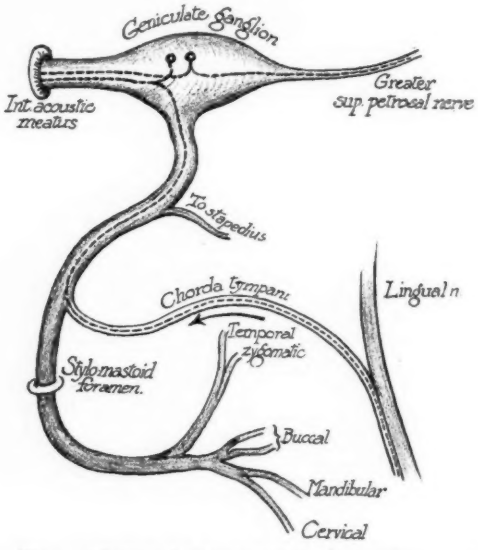

Fig. 4. Diagram showing essentials of intrapetrous part of facial nerve. (Modified from Gray.)

stantially new has been added by recent writers. With the increasing specialization in surgical work, it is not always an easy matter to determine into which specialty any given subject falls. Faciohypoglossal anastomosis is one of these "bones of contention." The general surgeon claims it as he claims everything as his province that requires the use of a scalpel and some things that do not. The otologist claims it. Very often he has a better right to it than anyone else, though not always on the ground that it requires more delicate handling than the general surgeon is prepared to give it (Beck). The neurological surgeon claims it inasmuch as it involves the peripheral nerves, and are they not part of his territory? The orthopedic surgeon claims it inasmuch as nerve suture in military surgery was by common consent handed over to him, and if one has had much experience in the suture of the noncranial nerves, why not apply that experience to the cranial nerves? Besides no one will deny that facial paralysis is a serious deformity. It does not matter from the patient's point of view whether the operator is a general surgeon or a specialist. What does matter is that the operator should know his anatomy, and should be able to handle delicate things delicately.

OPERATION FOR ANASTOMOSIS OF FACIAL AND HYPOGLOSSAL NERVES

An incision is made from well up on the mastoid process down to the greater cornu of the hyoid bone. This incision can be readily made in one of the natural lines of flexure of the neck and after the lapse of a few months is well-nigh invisible. The platysma is cut through, and the interval between the sternomastoid muscle and the parotid gland is thoroughly opened up. A few strands of fibrous tissue are usually encountered and occasionally a twig from the facial nerve may be found. The nerve itself lies somewhat deeply, a good inch from the surface of the skin, and generally about the level of the tip of the lobule of the ear. Its direction is in general transverse. It is important to avoid if possible opening the capsule of the parotid for the lobules of the gland tend to obscure the view and there is added oozing. This stage of the operation is at times difficult. There has usually been some removal of the

Fig. 5. The facial nerve—distribution on the face. (Modified from Cunningham.)

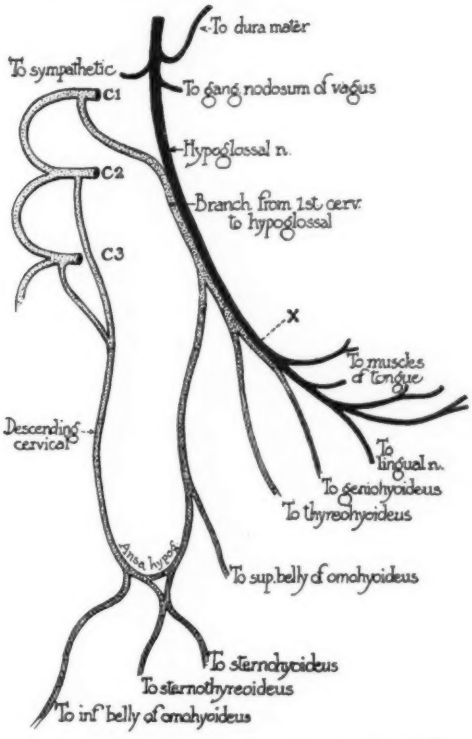

Fig. 6. The hypoglossal nerve — showing distribution, relation to cervical plexus, and *x*, the point of section in seventh and twelfth anastomosis. (Modified from Gray.)

mastoid process, and the scar tissue keeps on oozing so that the field of operation is kept clean with some trouble. If there has been degeneration of the nerve, its pinkish color renders it difficult to recognize, and its soft consistency makes injury easy. It also seems to stain somewhat with the oozing blood, and because of this it is not always easy to distinguish. Indeed, it usually occurs that the nerve has been in the field of operation for a short time before it is clearly identified. Next comes the process of isolating it up to the stylomastoid foramen. This may be difficult. The posterior auricular artery which runs along the upper border of the posterior belly of the digastric muscle, seems to send off numerous fine twigs which are always ready to shed a few corpuscles in the field, and there are equally numerous venous radicles assisting in the process. Again the nerve passes in to the deep surface of the mastoid process and it may be necessary to remove the tip of this prominence in order to make the exposure complete, as was done by Halstead.

Section of the nerve is then made at the stylomastoid foramen. As this is done, there is usually a small spurt from the stylomastoid branch of the posterior auricular artery. In the remaining steps of the operation one of several methods may be followed. The hypoglossal nerve may be isolated and divided, and then the distal end of the proximal segment brought up to meet the facial by tunnelling through the soft parts. This is apt to put some strain on the hypoglossal, and it is probably better to isolate the nerve so that there is a distinct sulcus in the upper part of the neck, the floor of which is occupied by the posterior belly of the digastric. This entails dealing with a number of veins notably the common facial vein and some of its smaller

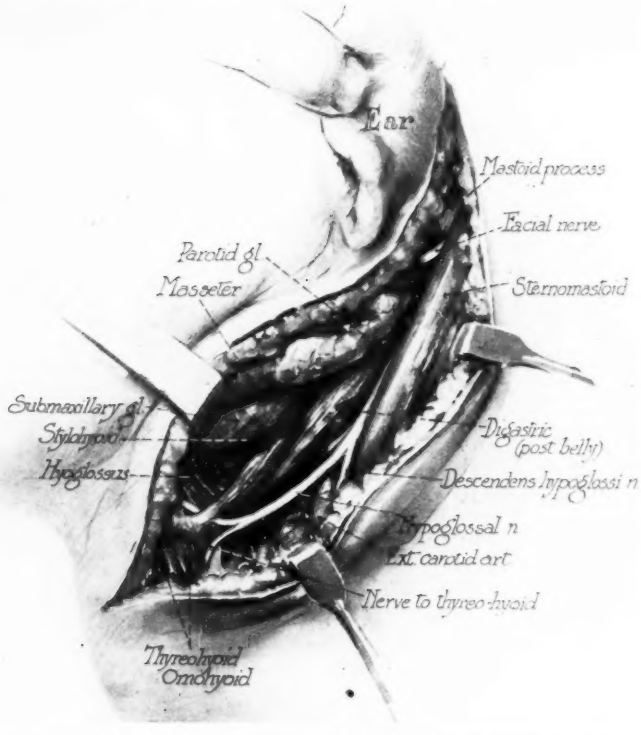

Fig. 7. Diagram showing essentials exposed in defining facial and hypoglossal nerves.

tributaries. The posterior belly of the digastric is the key to the region. Under cover of its upper border, far forward, the hypoglossal nerve is seen emerging to course superficial to the hyoglossus muscle; traced backward toward its origin, it will be noticed to give off the descendens hypoglossi to run downwards in close relation to the external carotid artery, carrying from the first cervical nerve, fibers to join with fibers from the second and third cervical nerves in the ansa hypoglossi from which a nerve supply passes to the infrahyoid muscles. The nerve to the thyrohyoid muscle is seen coming off as a separate branch and has to be sacrificed. It is usually possible to conserve the descendens hypoglossi. Soon after the hypoglossal nerve has come into relation with the hyoglossus muscle it is seen to break up into a leash of branches, which go to supply the geniohyoid (first cervical fibers), the genioglossus, and the intrinsic muscles of the tongue. The hypoglossal nerve is cut off just proximal to its division into numerous branches and is then amply long enough to permit of its being brought in contact with the proximal extremity of the distal segment of the facial without tension. When the anastomosis has been made it will be found to lie over the posterior belly of the digastric. The method of making the junction is a matter of choice. It is possible and desirable to make the union by stitching together the sheaths of the nerves without injuring more than is necessary the nerve fibers themselves. For this purpose the finest needles with non-cutting edge are employed, and as a result of experience, one is inclined to use fine silk. On the last occasion on which this operation was performed, I procured some of the finest Chinese twist silk and found it to consist of three strands. These were unwound and used as three

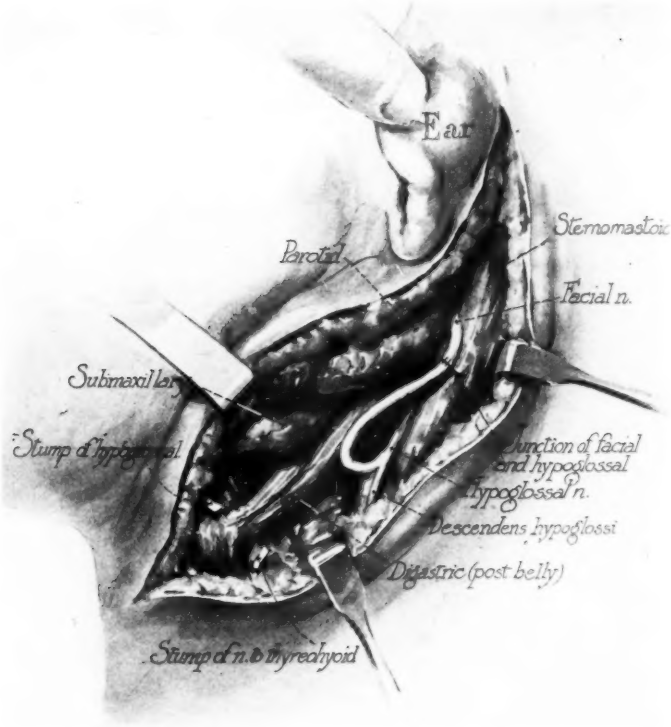

Fig. 8. Diagram showing anastomosis of facial and hypoglossal nerves.

separate sutures. As there is no tension on the sutures after they are tied, one is able to gauge the degree of strain which it is possible to employ. In using even the finest catgut, one is conscious of a lack of flexibility, which is apt to bruise the nerve. This is not the case in employing silk. Moreover, the experimental work of Sargent and Greenfield shows that fine silk is less irritating than plain catgut, although it is unabsorbable. No special bed is prepared for the junction. Deeply, it rests on the posterior belly of the digastric, while it is covered by the fatty tissues of the upper part of the neck. Hæmostasis is made very carefully; a drain may or not be put in according to whether one is satisfied or not with the dryness of the wound. For making the skin suture one may use silkworm gut, horsehair, or silk as it pleases the operator.

The operation is in no sense a dramatic one; it is apt to be tedious, and delicate handling is very necessary at all times. The nerves themselves are of small diameter, and the facial may be distinctly soft and friable, so that only the most gentle manipulation is permissible.

ILLUSTRATIVE CASES

CASE 1. Pte. W.H.C., age 27. In August, 1918, he had radical operation for cure of mastoid disease. Facial paralysis followed immediately on operation and was complete. At the request of the operator concerned, I performed faciohypoglossal anastomosis on Novmber 29, 1918. Incision was made from the mastoid down to the hyoid bone. Branches of the facial nerve were secured and followed up to the stylomastoid foramen. The hypoglossal nerve was then isolated up to the point where it was breaking into branches. Ends were brought neatly together with No. 00 catgut, three sutures. Skin was sutured with silkworm gut. No drainage.

Fig. 9. Case 1. W. H. C. March, 1921. At left, face in repose; center, showing movement; at right, showing tongue—note furrow.

This patient was under treatment with massage and galvanism for 6 months. He was then discharged from the army, and was not seen again by me until February 18, 1921. Examination on this date showed very considerable improvement. With the face in repose it was difficult to tell which was the paralyzed side. There was no drooping of the angle of the mouth and the palpebral fissure on the affected side was no more widely open than on the sound side. Voluntary movement was present everywhere except in the frontal region. The patient was unable to whistle. The electrical reactions of the muscles were tested and all including the outer fibers of the frontalis reacted to faradism. It was very beautiful to see the contraction of the tiny procerus (pyramidalis nasi) and nasalis (compressor naris). The tongue was remodelled so that it appeared as median mass with a deep furrow along the right side. Patient eats almost entirely with the sound side as he has not yet sufficiently great control to prevent the food lodging between the cheek and gum on the affected side. Emotional use of the facial muscles is confined to the unaffected side.

Case 2. J. S., age 36, chartered accountant. This patient was seen by me for the first time on December 5, 1918. He complained of right-sided facial paralysis. Onset was gradual about 7 years previously. The cause was quite unknown to him. During the last 4 years the paralysis had become very much more marked. He had had no operation and no history of suppuration in the middle ear. On examination there was found a complete facial paralysis of the right side. Taste was tested and inaccurate response was given for the anterior two-thirds of the tongue on the right side (Chorda tympani). The atrophy of the facial muscles was very pronounced. He had practically no hearing in the right ear. There was no paralysis of the soft palate and no atrophy of the tongue. Knee-jerks were present and were not exaggerated. Electrical reactions of the facial muscles showed no reaction to faradism, and a very feeble reaction to galvanism. Cathodal closure contraction was stated to be slightly greater than anodal closure contraction. Specialist's report on the ear condition was as follows:

"Examination of Mr. J. S. shows otitis media catarrhalis chronica in both ears, worse in the right ear with involvement of the seventh and eighth nerves in right ear. Lesion of both nerves probably in the internal meatus. Would advise radiograph of the mastoid bones."

Radiographic examination like the report of the ear specialist added nothing to our previous knowledge. A Wassermann test of the blood proved negative.

On January 13, 1919, operation was performed. The facial nerve was identified and traced up to the stylomastoid foramen where it was severed. It presented no very obvious abnormality. The hypoglossal nerve was isolated in the neck, the branch to the thyrohyoid was sacrificed, and a junction made between the facial and hypoglossal nerves by three sutures of No. 00 catgut. As there was considerable oozing a drainage tube was inserted for 24 hours. The stitches were removed in a week and shortly thereafter massage and galvanism were commenced. These were continued for 6 months. Voluntary power was noticed first of all in the

Fig. 10. Case 2. J. S. At left, taken July, 1918, showing condition before operation; center, face in repose; at right, attempt to smile. Center and right photographs taken November, 1920.

muscles about the eye on November 26, 1919. On February 6, 1920, it was noted that voluntary power was present in all the muscles of the right side of the face. Patient spent a considerable part of the year in England, and on October 22, 1920, on the first visit after his return, a note was made to the effect that "the improvement is very remarkable. The brow on the right side can be raised fairly strongly, and the right eye can be almost closed. Action of the muscles around the mouth is also extremely good. In repose it is almost impossible to tell that there is any paralysis."

Case 3. Pte. L. B., age 35, sustained a gunshot wound of the head on August 9, 1918. Facial paralysis was immediate and complete. The bullet passed from just in front of the left auricle to the middle line of the neck posteriorly. On March 21, 1919, the facial nerve was exposed and found "somewhat atrophied and degenerated." The hypoglossal nerve was then isolated and the branch to the thyrohyoid was cut through. The seventh and twelfth nerves were then joined by No. 00 catgut, three sutures. As oozing had been considerable, a rubber drainage tube was put in for 24 hours. The skin was sutured with silkworm gut. Shortly after this the patient received his discharge from the army, and was not again seen by me until February 18, 1921. Voluntary movement was then present in all muscles of the left side of the face including the frontalis. The platysma was acting quite strongly. Patient could close the left eye completely and was able to whistle quite well. A reaction to faradism was obtained in all the muscles of the left side of the face. The tongue was protruded

Fig. 11. Case 3. L. B. March, 1921. At left, face in repose; center, in movement; at right, showing tongue.

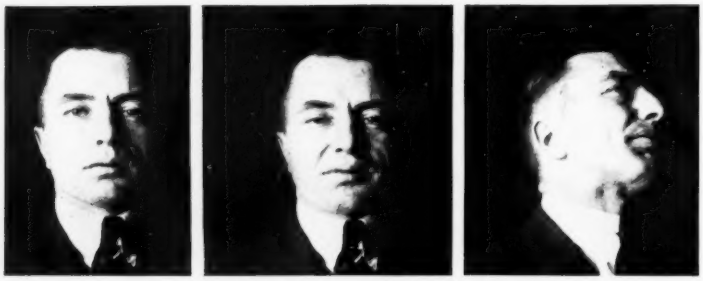

Fig. 12. Case 4. J. C. M. April, 1920. At left, face in repose; center, in movement; at right, showing scar.

Fig. 13. Case 5. E. E. February, 1921. At left, face in repose; center, in movement; at right, showing scar.

straight and no difficulty was observable in articulation of labial or lingual consonants.

Case 4. Cpl. J. C. McV. had operation done for radical cure of mastoid infection in August, 1918. This was followed by immediate and complete paralysis of the right side of the face. At the request of the otologist, anastomosis of facial and hypoglossal was performed on April 4, 1919. The operation proved somewhat difficult. The landmarks were somewhat obscure, the greater part of the mastoid process having been removed. The scar tissue was extremely troublesome from constant oozing, and in addition, there was a number of enlarged lymphatic glands with a good deal of matting around them. The facial nerve, however, was isolated and cut across above its division into cervical and temporal branches. Junction between seventh and twelfth nerves was carried out with four No. 00 catgut sutures. The skin was sutured with silkworm gut. For this patient an appliance was made with a view to keeping the facial muscles relaxed. It consisted of a small metal flange hooking into the labial commissure with a metal ear hook. The outside of the oral flange was painted flesh-color. The apparatus appeared to present no advantages over a cigarette mouthpiece, and was lacking in some of the potentialities of the latter. Frazier has used a strip of flesh-colored adhesive, drawing the angle of the mouth upwards toward the ear. A report on this patient was made on April 6, 1920: "Voluntary power was present in the lower part of the face, but no voluntary power in the muscles above the eye." A photograph was taken on April 10, 1920.

Case 5. Pte. E. E., age 49. This patient was seen by me for the first time on April 14, 1919. His history was that in the beginning of March, 1919, he had had a left mastoid operation. Facial paralysis was immediate and complete. It was decided to see if any improvement could be brought about by massage and electricity. This was persevered with until August, 1919, but no return of function occurred.

On August 25, 1919, anastomosis of facial and hypoglossal was carried out. It was noted that the facial nerve was somewhat pink and had the usual appearance of a degenerated nerve. Three No. 00 catgut sutures were used. A tube was left in for drainage for 48 hours. Skin was sutured with silkworm gut. Treatment with massage and galvanism was instituted and was kept up for 12 months. On August 30, 1920, it was noted that distinct voluntary movement was present in practically all the muscles of the face. The transverse lines of the forehead were well marked and the nasolabial fold was clearly seen. Treatment was stopped at this time.

Fig. 14. Case 6. E. L. J. February, 1921. At left, before operation; center, face in repose; at right, the scar.

He reported again on November 25, 1920, and at this time voluntary movement did not appear to be so good as at the last time of reporting.

Patient was again examined on March 3, 1921. Voluntary movement was present in all the muscles of the face, and all reacted to faradism. Patient cannot whistle. The right eye cannot be closed independently of the left eye. The flexure lines of the face are particularly well marked in this patient and the wrinkles on the right side of the brow are well seen.

CASE 6. Sgt. E. L. J., age 31. In February, 1919, this patient had a radical mastoid operation done on the left side, and a few weeks later this was followed by a second operation. In July, 1919, the cochlea on the same side was extirpated. This last operation was necessarily followed by complete right facial paralysis. The patient was sent to me on October 4, 1919. Electrical reactions were tested, and showed reaction of a degeneration present in the muscles of the right side of the face. On October 8, 1919, in spite of the fact that the last operation wound was not completely healed, anastomosis between the facial and hypoglossal was carried out. The operation was rather difficult. The landmarks were obscure; there was a good deal of scar tissue; and the division of the nerve into temporal and cervical divisions occurred very soon after the exit from the stylomastoid foramen so that the length of facial nerve available for union was rather short. In addition it was distinctly swollen, pinkish, and soft. At operation I was not at all satisfied with the neatness of the junction, and gave a doubtful prognosis. This gloomy view was accentuated by the fact that the wound became septic in the upper part, probably owing to secretion from the still unhealed previous wound. The patient maintained a constantly hopeful attitude and persevered with massage and galvanism for a whole year. On February 10, 1920, a note was made stating: "The face seems better although no voluntary movement is shown. It is not likely that good result will be secured in this case."

On August 23, a note was made: "There is no improvement in electrical reactions. The result in this case is almost certain to be disappointing. Recommended that he cease electrical treatment and return to work." On November 2, 1920, he rang me up to say that he had some voluntary movement, and when I saw him I was able to confirm that voluntary power was present in the zygomaticus muscle and around the mouth. Since then there has been steady although slow improvement.

CASE 7. H. A. E., age 29. On February 27, 1920, this patient had a radical mastoid operation done on the right side. Facial paralysis followed immediately and was complete. Examination showed the mastoid wound incompletely healed on March 13, 1920. Electrical reactions showed no reaction to faradism. Recommended that nerve anastomosis be performed when healing of the mastoid wound was complete. On July 14, 1920, the wound had

Fig. 15. Case 7. H. A. E. February, 1921. At left face in repose; at right, in movement.

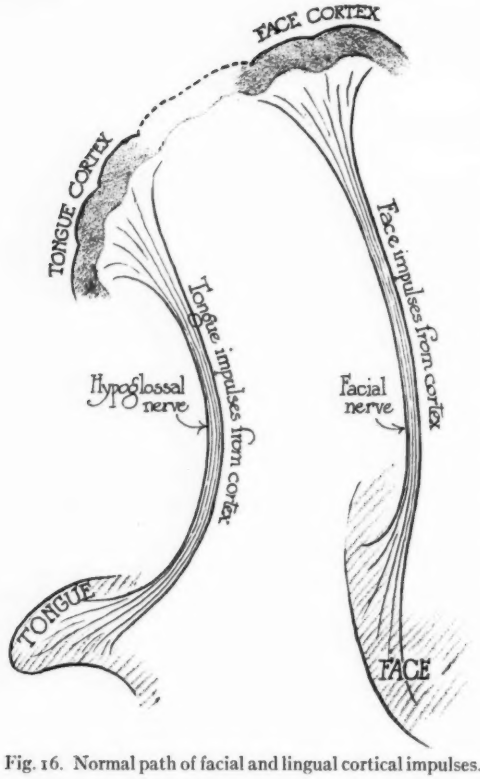

Fig. 16. Normal path of facial and lingual cortical impulses.

completely healed, and operation was done. In this case I was not satisfied with the fineness of the catgut provided and used two fine silk sutures. A stab drain was placed at the bottom of the wound to carry off excess of blood. This was removed in 24 hours. On July 19 stitches were removed and patient went to work. Massage and galvanism were begun at once and were continued for 6 months. On November 20, a note was made that there was no sign of voluntary movement but that the mouth was becoming more transverse, and the right eye was not so widely open. On December 29, 1920, voluntary power was still absent. Toward the end of January, 1921, voluntary power began to show itself in the angle of the mouth, and this has gone on steadily improving. On February 15, 1921, patient was able to whistle for the first time since his operation.

CASE 8. Ex-Pte. J. H. This patient came complaining of intractable facial tic. In 1915, he was gassed and taken prisoner at the second battle of Ypres. For 3 years and 8 months he was a prisoner of war in Germany. He first noticed the facial spasm shortly after he was taken prisoner, and from that date to this it has become steadily worse. The spasm was almost continuous, it was present to some extent, he was told, even during sleep, and was a source of much embarassment to him in company, and provided an unending fund of merriment to his mates at work. He had had treatment of every possible kind, including persistent suggestion. The condition, however, continued to grow steadily worse. His own idea in coming was to have the muscles paralyzed if possible. The result of operation on the face, the probable duration of the paralysis, the loss of power in one-half of the tongue, every disadvantage that could be thought of were put before him, and he preferred to face them rather than continue a victim to the never-ending tic. Examination bore out the reasonableness of his decision, for the left side of the face was in constant movement, the left eye alternately screwed up tight and relaxed, the left angle of the mouth drawn up and indeed the whole side of the face in irregular movement. There appeared to be some weakness of the muscles combined with the spasm, for when he was asked to raise the brow, it did not rise so high on the affected as on the sound side. Again, when asked to show his teeth there was a marked difference in the two sides. The condition seemed exactly parallel to a spasmodic torticollis, a condition which like facial tic is of unknown but probably cortical origin.

Operation was performed on February 17, 1921. When patient was going under the anæsthetic, it was observed that the spasm of the muscles of the left side of the face continued until he was fairly deeply under. The facial nerve was exposed without any difficulty and it was found advisable to remove the tip of the mastoid process in order to expose the point of exit from the stylomastoid foramen. The hypoglossal nerve was then exposed. and its branches identified. It was cut far forward on the hyoglossus muscle, and turned up toward the stump of the facial. Union was made by three very small silk sutures obtained by untwisting the finest Chinese twist silk. The deep tissues were brought together with No. 1 plain catgut, and the skin sutured with horsehair. No drainage was allowed for. When seen the day after the operation he was able to express as much satisfaction with one side of his face as is normal with both sides. The relief from the constant spasm was very great. It is too early to have any idea of the ultimate results in this case, but even if paralysis should be permanent—which is not likely—and complete, the exchange from the contortions of a facial tic is a good one. In this case there was no nerve degeneration and no muscle atrophy. The operation of anastomosis was therefore comparatively easy, and done under the most favorable auspices for return of muscle function.

COMMENT

A study of the literature bears out the general conclusion that return of muscle

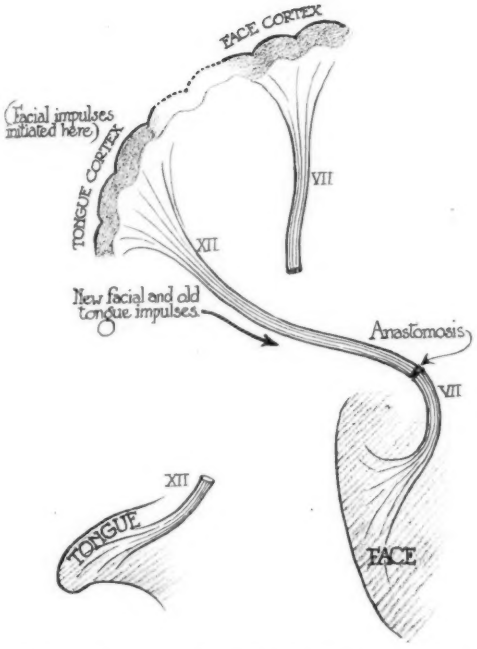

Fig. 17. Path of impulses if facial cortex ceases to function directly.

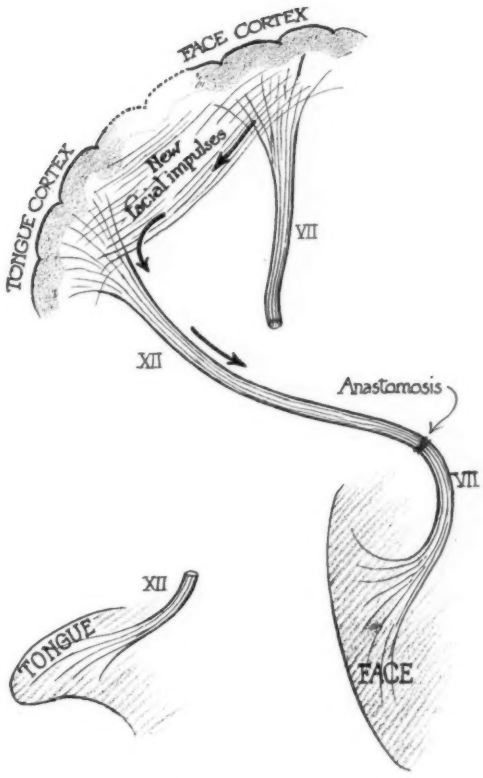

Fig. 18. Path of impulses if facial cortex functions through hypoglossal cortex.

tonus may be looked for with some degree of confidence and that a considerable amount of voluntary control of muscle movement is probable. If emotional movement of the face is desired it is usually absent. Why is this? We must bear in mind that in the cortex there are represented movements, not muscles. Probably no voluntary movement in the body is accomplished by any single muscle. For every action we have to take into account not only the "prime mover" but the antagonistic muscles which, as it were, "pay out the slack," the synergic muscles, and sometimes the muscles of fixation. The actual movement is thus a complex, not a simple phenomenon, and the cortical accompaniment is of necessity equally complex, demanding a high degree of co-ordination. The play of the facial muscles in the expression of the emotions is a very subtle complex, capable of almost indefinite combinations giving rise to infinite gradations of emotional expression. The facial cortex must likewise be capable of emitting equally numerous combinations and degrees of nerve impulse. In facial paralysis this mechanism is, to use Cushing's phrase, "sidetracked." The tongue cortex has relatively much simpler duties. Obviously the only means of re-acquiring emotional activity in the facial muscles after hypoglossal anastomosis is by educating the hypoglossal cortex to perform the complex work of the facial cortex or by connecting the facial cortex with the tongue cortex so intimately that the path for impulses from facial cortex through tongue cortex to facial muscles is as free as it was formerly when it ran directly from facial cortex to facial muscles. Either of these must be a matter of some difficulty requiring considerable time to bring to perfection. It is likely to vary in different

individuals just as the readiness with which new knowledge is acquired varies from one to another. Other things being equal, it is likely to be carried further and to be more complete the younger the age at which the change is made necessary. In all probability after middle life the formation of new paths or the acquirement of new duties by a part of the cortex is very imperfectly carried out. The facial muscles are likely to speak as it were with a lingual accent.

Bearing to some extent on this problem is the question of muscle re-education. Up to the present we have tended to regard the work of repair as practically finished when voluntary movement has been restored. Experience with cases of tendon transplantation has abundantly proved that adaptation to function in the transplanted tendons only begins when they are firmly attached to their new insertions. Even in such simple activities as are carried out with the muscles usually re-arranged, in tendon transplantation for irreparable musculospiral paralysis, the process of education takes many weeks, and the muscles which are being educated were never paralyzed at all. How much more then must we ask in the case of facial muscles which have much more complex duties to perform, which have been atrophied for a considerable time, and in the end have to receive orders from nerve cells which may be only learning their work. Education in the use of the facial muscles ought to be constant and persevering. Each patient, if intelligent enough, should have the elements of the nerve-muscle mechanism explained to him, and it should be pointed out that future improvement lies largely with himself. Apart from deliberate re-education, it is doubtful if emotional movement will ever be regained; with intelligent self-education, it is at least a possibility.

The choice of the hypoglossal rather than the accessory is in conformity with this opinion. We are accustomed to use the medium of speech in emotional expression rather than our sternomastoids and trapezii. Again, the actions of the tongue are of finer grade, and are very much more numerous than are those of the shoulders, so that nerve impulses from the cortex must be passing along the new path much more frequently in the case of faciohypoglossal than in the case of facio-accessory anastomosis. The proximity of the speech center in the cortex to the face region may also have some slight influence in the matter of developing associations between facial and lingual areas of cortex.

From the nature of the condition and from the fact that a sufficiently long period has not yet elapsed in any of the cases described, it is rather difficult to draw conclusions as to the scope of the operation and the degree of improvement to be looked for. I have, however, attempted to analyze the elements in the result, which would enable us to estimate to some extent the question of success or failure. These may be grouped according to the anatomical region: the brow, the palpebral fissure, the cheek, the mouth, and the tongue. Each of these may again be regarded from the standpoint of appearance and that of function. Thus, in regard to the brow, one may note the presence of wrinkles such that in repose the forehead looks almost normal, yet when it is intended to express astonishment by raising the brow, or by frowning to indicate displeasure, the forehead may remain impassive. Similarly in the case of the palpebral fissure, the proportions may correspond to that of the opposite side, and yet in the presence of a strong wind the affected eye may be troublesome from watering. In the case of the cheek, the appearance may be indistinguishable from that of the other side, but the food may still tend to collect between it and the gum. The mouth also gives a variable result according to whether we estimate appearance or function. The angle of the mouth may be well elevated, the oral slit exactly transverse when the face is at rest, but though the lips may be capable of performing the minor function of whistling, or even of forming the labial consonants without any trouble, the smile is apt to be one-sided. This may be an advantage in a game of poker but on most occasions it is to be counted as a drawback. On the debit side of the account must be set down the necessary interference with the functions of the tongue. In regard to the sensory function of

taste, the patient is never conscious of any difference. The motor functions of the tongue are mainly three. It is used in mastication, in swallowing, and in speech. In none of these three respects is the loss of power in one-half of the organ a very serious factor, and in all three it tends to become less noticeable as time goes on. The matter of the appearance of the tongue is of little moment; small girls alone habitually exhibit the organ.

It must be evident that the question of a successful issue to this operative procedure depends on a large number of factors most of which, variable in themselves, are variously appraised by different people. Further, the number of cases in this series is too small for us to formulate definite conclusions, but it is sufficient to warrant the opinion that facio-hypoglossal anastomosis is a measure of distinct utility, an opinion which up to the present is shared by the patients.

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MOVABLE BODIES IN THE KNEE-JOINT[1]

By O. F. LAMSON, M.D., F.A.C.S., Seattle, Washington

FOR many years free osteocartilaginous joint-bodies have been of great interest to surgeons, and many efforts have been made to find the true cause and manner of growth of these troublesome bodies. There may still be some doubt in the etiology, yet the clinical features are definite and the treatment is one—namely, surgical.

Hunter's *Pathology*, regarding the life history of these completely detached and freely wandering bodies, may be faulty, yet coming from the latter part of the eighteenth century it is interesting. He maintained "that blood, when effused, tended to organize and to adapt itself to the tissues in which it was effused. Hence, loose bodies in the knee were organized blood clots that became attached to the articular cartilage, assumed its character, and later, becoming detached, gave rise to movable cartilaginous bodies."

The present well accepted etiology of free joint-bodies—a piece of detached cartilage or of bone and cartilage—must be attributed to George Rainey of St. Thomas Hospital (1801-1804). He made the observation that detached loose bodies, like a cell of metastatic growth, may continue to grow in a new locality independent of its parent structure, though adhering to its character. Further studies definitely established that such free bodies are nourished by the lubricating joint fluid—the synovia; similar to the bony growth which develops in myocitis ossificans traumatica and receives its nourishment from the neighboring contiguous muscles.

While such osteocartilaginous bodies are found in all the other joints, they are more common in the larger hinge-joints, especially in the knee where they are often of traumatic origin, this joint being more subject to injury than any other joint, due perhaps to its comparatively superficial location, between the two longest bones of the body; and the fact that the knee has a double function to perform—locomotion and bearing the whole body-weight from different angles for which nature has supplied it with a very elaborate ligamentous support. These ligaments are but slightly assisted by the muscles and the bones entering into the formation of this joint.

Therefore, we may say the frequent cause of derangement of this joint, injury of the ligaments and the semilunar cartilages is due to the strenuous work it has to perform and to the peculiar motion of the joint, which is a combination of gliding and rolling (Morris).

Though this joint belongs to the ginglymus or hinge variety of diarthrosis, during extreme flexion, it has to allow a certain amount of rotation of the tibia in its long axis, and a little abduction and rotation of the leg on the thigh. According to Henderson, "the maximum of these movements occurs in the arc between an angle of flexion of about 30° and an angle of flexion of 90°. This arc may be spoken of as the arc of weakness. It is in this arc of weakness that the majority of mechanical derangements of the knee are sustained." Direct trauma especially when the knee is in flexion may result in nipping some cartilage and bone from the condylar surface of the femur. Once detached, such osteocartilaginous bodies wander about and are nourished by the joint fluid and may grow to a considerable size

A great many "joint-mice," as they are often termed, originate in the intra-articular cavity and may be a part of the semilunar fibrocartilages, which are two in number and are placed horizontally between the articular surfaces of the femur and the tibia. However, neither of them is sufficiently large to cover the whole of the tibial articular surface upon which it rests so that when, during the peculiar rolling and gliding movements of the joint, some undue pressure is brought upon the tibia it may cause the semilunar cartilage to become detached. Further, the upper and lower surfaces of both semilunar cartilages are smooth and free and each cartilage terminates in an anterior and posterior fibrous

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Fig. 1. Roentgenogram showing loose bodies in joint.

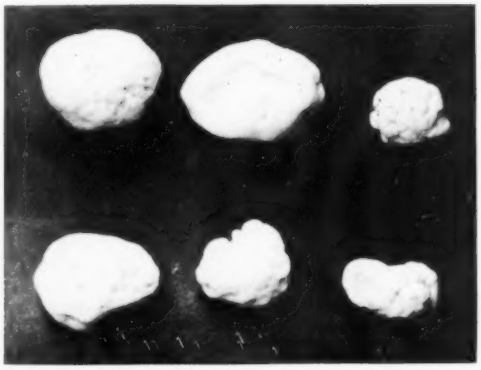

Fig. 2. Loose joint-bodies removed from knee of T. J. M

horn or cornu, which may be clipped off and the detached bodies may become foci of such movable bodies. Villous projections into the joint may likewise be rubbed off, float about at will and become engaged in the joint resulting in its complete "locking," accompanied by severe pain.

The synovial membrane is also of special importance in this discussion because through injury it probably becomes a frequent source of loose bodies in an otherwise healthy joint. Therefore, it will be well to recall some of its anatomical characteristics.

In the knee-joint the synovial membrane is not only the largest but the most elaborately arranged of its kind in the body—representing the fusion of three separate synovial membranes, which, in some animals, remain permanently distinct.

The portion of synovial membrane which extends from below the level of the patellar articular surface to the anterior part of the intercondyloid notch, lines the joint cavity, and forms a more or less extensive covering for the intracapsular ligaments and for the free surface of the infrapatellar pad of fat. At its femoral end it is narrow and attenuated, but at its patellar end it expands laterally to form winglike fringes or membranes, which may through disease or infection and chronic irritation hypertrophy—become pedunculated—undergo proliferation by fibrous tissue formation and be translated into calcareous formation. Through a sudden not necessarily violent movement of the joint, these osteocartilaginous fringes may be nipped off and give rise to loose joint bodies.

Even the articular surface of the synovial membrane may, through constant irritation, become papillated, causing instead of a smooth, a rough friction, a condition which will aggravate an already existing synovitis and bring about the thickening and hardening of the villi, or warty growths, which also may become liberated in the joint cavity. Such free bodies may become engaged in the articulations, also "locking" the joint. Further, during the act of "unlocking" they may be bruised and crushed. In this manner they may increase their number and keep up the vicious circle until surgical interference is sought. Thus synovitis and arthritis may be the result as well as the cause of loose bodies in the joint.

My associate, Dr. A. R. Robertson, who has been especially interested in the study of these bodies from a standpoint of pathology and etiology, made the following observation, that in a chronically inflamed joint distended with fluid, the synovial membrane is stretched, thickened, and œdematous. After a prolonged period certain areas of the thickened membrane might undergo an analogous translation into cartilage and bone. With subsidance of the fluid the membrane would be lax and flabby. In consequence the osteochondromatous areas would act as foreign bodies.

Such areas would fail to accommodate themselves to the varying movements of the joint. In time they would become pedunculated and eventually pulled away to become now a detached free body within the joint. His belief is that there is no growth after they become fully detached.

It has been stated that certain individuals suffer from a condition known as "osteochondritis dissecans," when the surface of the knee-joint is especially brittle and some insignificant trauma causes the detachment of a portion of the articular surface.

The symptoms of this affliction are usually quite typical—intermittent "locking" of the knee-joint, in the flexed position, which is accompanied by excruciating pain. During the act of "unlocking" the patient is conscious of something slipping out. The swelling in the joint that is apt to follow is due to injury to the tissues and to consequent effusion of fluid into the joint. It is quite possible, especially if the loose bodies are of considerable size and lodged in the extension of the joint upward—in the suprapatellar pouch—that they may hinder locomotion slightly as there is less likelihood of such large bodies, owing to their thickness, to glide into and become engaged in the joint. Especially is this true if the egdes of the bodies are more or less rounded and spherical in shape. Quite often the movable bodies in the knee can be easily palpated by flexing and extending the knee-joint, especially when they are located in the suprapatellar pouch.

If with the history of "locking" and with well pronounced characteristic symptoms there is to be felt dense bodies which can be moved from place to place, the diagnosis is not difficult. Often they are found and isolated by the patient. Sometimes the history of the mode of production is helpful. It is well to bear in mind that symptoms of nipping of a synovial fringe are not as pronounced and the pain is not as acute in its primary occurrence.

To make a positive diagnosis, to the clinical evidence must be added the X-ray pictures, but merely as a corroborative agent. The X-ray examination generally is a great aid in detecting any such bodies in the knee—and stereoscopic observations are especially useful in definitely locating their relative position in the joint.

A few guides to the accurate reading of such X-ray plates follow.

The picture of osteocartilaginous loose bodies is quite characteristic, as they present themselves as well defined, uniform shadows of individual structures.

Dislocated semilunar cartilage will not give any X-ray evidence, except when incrustated.

Degenerated fat pads, due to chronic disease such as tuberculosis and syphilis, may be palpated but X-ray will not reveal them.

A sesamoid bone in the internal head of the gastrocnemius in certain positions may cast a shadow which can be mistaken for a loose body.

Joint lipomata may cause "locking," may be even felt, but will not have the characteristic picture of "joint-mice."

The attending physician's first duty is to relieve pain and "locking" and establish motion. With manipulation, forced flexion, and sudden extension, the offending loose body may be dislodged. Surgery only will give lasting relief. If the presence of "joint-mice" is associated with arthritis deformans and the joint is already considerably impaired, the removal of the loose bodies will be of little benefit. It is well to bear in mind that surgery does not cure the causative lesion; therefore, similar bodies may reform.

If the treatment, as in most cases, is to be surgical, during operation the joint should be subjected to as little trauma as possible, and more than the ordinary care should be taken to guard against infection.

The method of approach in each case must be decided in accordance with the requirements in each individual and depends on the location of the joint-mice. If complete exposure of the joint is required, the longitudinal division of the patella may be imperative. But this procedure naturally entails more injury to the joint than the safer longitudinal incision of the external surface of the joint. The diagonal incision following the internal line of the joint is preferable for the removal of the internal semilunar cartilage and other free bodies within the joint.

To prevent ankylosis, mobilization of the knee should begin as early as possible.

The biology and the gross appearance of such joint-bodies is remarkably constant. In shape they are generally plano-convex or concavo-convex; the latter aspect being perfectly smooth, while the plane or concave surface is uneven, roughened, or nodulated. They may not always be found free but may be found fixed in a fossa or excavation in the articular surface of a femoral condyle—or they may be found in close relation to the crucial ligaments in the intercondylar space. On rare occasions they are pressed between the bones and lie snugly imbedded in a fossa in the articular cartilages.

It is known that denuded and injured articular surfaces of bones in time become covered over by smooth, white, hyaline articular cartilage. This is true of joint-mice as well. When carefully examined they will be found to be covered with a thick shining white layer of hyaline cartilage. Sometimes on the smaller concave side may be found a thin layer of true spongy bone, especially when the removal takes place soon after injury. Undoubtedly the appearance, shape, and biological contents of specimens depend primarily on their origin, evolution, and growth.

I wish to present briefly one case which in my experience is unique because of the size and number of bodies present and the comparative slight disability the patient suffered. Had I followed the apparent X-ray findings in this case, the joint would have been unnecessarily subjected to additional trauma by a third incision for the seventh loose body. But it proved to be the peculiar shadow of the sesamoid bone, which photographed from a certain angle gives an identical picture of "joint-mice."

T. J. M., male, age 26; truck driver. In 1912 when playing baseball he accidentally twisted his right knee. One year later he injured it again when a heavy weight fell on it.

Since the first accident he has experienced about twice a month intermittent "locking" of the knee in a flexed position at an angle of about 45°, accompanied by severe pain. With great effort the leg was straightened. Each time the patient was conscious of something slipping in the joint and then he was relieved of pain and "locking." This condition was followed by more or less swelling of the joint. There has been a constant moderate swelling since the first injury, otherwise he is in robust health and shows more than the average muscular development. He was prevented from attending to his work only twice during the history of his first trouble and then for only 2 or 3 days.

Fig. 3. Roentgenogram 1 year, 6 months after operation.

Wassermann test was negative. The other joints are in normal condition. The right knee is moderately swollen and several loose bodies can be palpated. X-ray examination revealed what appeared to be seven loose bodies in the joint, one between the articulating surfaces of the joint.

Operation, June 9, 1919. Removed six osteocartilaginous bodies from the right knee-joint, ranging in size from 1¼ inches in diameter to ½ inch in thickness, to the size of a small almond, one of which was attached to the joint surface by a fibrous band and located between the articulating surfaces. This one was removed through an incision about 2½ inches long following the line of the joint internally. The other five were removed by longitudinal incision external to the joint. The irregular anterior surface of the tibia indicates this area as the possible origin of these loose bodies.

Pathological report. The surface of specimens is of glistening whiteness, is everywhere pitted so that it presents numerous bosses. In some there is what appears to be a large depression to which a little connective tissue is attached, possibly the remains of a pedicle. Microscopic sections show a surface of dead connecting tissue beneath which this tissue shows gradual change to hyaline cartilage, the fibrocartilage, and then a beginning calcification of the interstitial hyaline substance. In places the cells undergo rearrangement into columns and true bone is formed.

He made a good recovery and has had no trouble since the operation. A recent X-ray indicates no recurrence.

EPIDERMOID CYSTS

By HENRY H. SHERK, M.D., F.A.C.S., Pasadena, California

THE subject of this paper is not important from the standpoint of the seriousness of the condition but it is of interest because, as a pathological entity, epidermoid cysts are very seldom recognized, and, to the majority of operators, entirely unknown. A number of surgeons were recently asked as to the frequency of epidermoids in their practice. All either pleaded ignorance as to the nature of these cysts or had them confused with either true dermoids or sebaceous cysts.

Some 14 years ago the difficulty of arriving at a postoperative diagnosis of a growth, which was thought before excision to be a possible skin sarcoma, first drew the writer's attention to these cysts as differentiated from follicular, retention, or sebaceous cysts. The observation of several other cases, in the course of a few years, led him to report them to the Clinical and Pathological Society of Los Angeles, none of whose members had ever seen any of these growths.

Since then Dr. Black has been on the lookout for these cysts in the material referred to him by others for examination. Nevertheless, until the recent requirement of some of our hospitals that all tissues removed at operations must be examined by a pathologist, none had passed through his hands. But within the last year he has had 4 cases occurring in the practice of four different surgeons and during the same period the writer has operated upon 5 patients presenting this form of tumor. Evidently these cysts are of frequent occurrence but mostly unrecognized because unexamined pathologically.

The literature on epidermoids until recent years was rather scant. Garré, in 1894, comments on the rarity of anything on the subject.

The term "epidermoid cyst" has been variously used by writers to describe cysts occurring in at least three widely different localities—the pelvis, the brain, and the external surface of the body. The pelvic epidermoids of embryonic origin and those of the third ventricle (14 and 15), resulting from an inclusion of the craniopharyngeal duct, will not be considered in this paper. These latter cysts, however, are of extreme interest and importance from their relation to tumors of the hypophysis and to hyperpituitarism and hypopituitarism. Only cysts of the body surface will be discussed.

These surface cysts, as such, were first described by Garré (3) under the name of "traumatic epithelial cysts." They have been variously termed by others as atheromata, inclusion cysts, implantation cysts (Sutton), and, finally, by Franke as epidermoids. This latter name best defines their histological characteristics and is undoubtedly the most acceptable designation.

The various writers have held mainly to two opinions as to the etiology of these cysts, traumatic and congenital. There are perfectly good grounds that either theory is right in certain cases. Some are undoubtedly traumatic in origin and many others as certainly congenital.

Franke (1) was the first to discard the old doctrine of the sebaceous gland origin of atheromata. He (3) thought they were fœtal inclusion cysts.

Then Toerrok (1) further confirmed the new theory of the embryonic ensnaring of atheroma germs by a detailed histological investigation of the walls and contents of these cysts.

Unna (1) agrees with Toerrok that true atheromata are a sort of simple dermoid and are developed from embryonic aberrant germs.

Gros and Reverdin (3) were the first to suggest the traumatic mode of origin.

Bland-Sutton (11) thinks they are traumatic in origin and calls them implantation cysts.

Pels Leusden (2) believes that they have their origin in superficial tuberculous lesions; that, following suppuration, the epithelium turns inward and, creeping along the fistula, lines the whole cavity.

Csillag (12) speaks of cysts following vesicular skin diseases and in scars resulting from injuries and quotes Kaposi, Neisser, Petrinni, Crocker, Vidal, Hallapeau, Duehring, and others. Warner (8) reports a case occurring in a herpetic scar.

Blumberg (2) claims that all are cholesteatoma or pearl cysts.

Franke (1) thinks only a small part result from traumatism and that many of these are due to trauma without injury to the external surface. This latter opinion is hard to understand.

Cederbaum (4) quotes various authors as to the theories of origin and believes that only a small percentage of epidermoids are caused by traumatism.

Woerz (3) reviews 55 cases, 24 of which gave distinct history of traumatism mostly after punctured wounds, one after hammer blow, three following panaritium.

Pietzner (3) collected 73 cases, 43 having history of trauma, including dog bite, hammer blow, incised wounds, penetration with pieces of wood, punctured and contused wounds.

The theory of traumatic (3) origin is strengthened by the experimental observations of Kaufman (4), Masse (4), Ribbert (4), Manasse and Schweninger (3), that detached pieces of surface epithelium, transplanted under the skin or fascia and in tendons, proliferate and form small cysts.

Franke (2) notes the absence of ducts or external openings in epidermoids as against their being retention cysts. The presence of papillæ with the absence of sebaceous cells was noted by Toerrok (1).

A brief reference to the anatomy of the skin will aid in an understanding of the origin and the differentiation of these cysts from other cysts of the body surface.

The skin consists principally of a layer of vascular tissue, named the derma, corium, or cutis vera. External to this is a layer or covering of epithelium termed the epidermis, cuticle or scarf skin. Under the derma or true skin is the subcutaneous cellular layer containing the skin appendages, namely, hair follicles, sweat glands, and sebaceous glands.

The epidermis is an epithelial structure belonging to the class of stratified squamous epithelium, arranged in four strata, namely from within outward, rete malpighii, stratum granulosum, stratum lucidum, and stratum corneum.

The most superficial stratum of these cells, called the stratum corneum, is composed of many layers of horny epithelial scales.

It is these horny scales that, when desquamated, form the principal content of the epidermoid cyst, and the four strata of the epiderm are found in reversed position in its walls.

Only the elements of the epiderm are found in the walls and contents of these epidermoids. The dermoids, however, contain the elements of both the corium and the epidermis, as well as those of the skin appendages—hair, teeth, sweat glands, and sebaceous glands. The sebaceous cysts are follicular or retention cysts, and show the histological elements and secretion of the sebaceous glands or their ducts.

Unna (1) describes the atheromata or epidermoids clinically as "subcutaneous, indolent tumors, varying in size from that of a pea to a walnut, which distend the skin hemispherically, show no opening and contain gritty, glistening, odorless débris of horny cells, mostly occurring in the hairy scalp, often multiple, slowly growing, lasting for years, and showing periods of growth and arrest alternately." He further says: "Histologically they are defined as an epithelial collection cornified in the center and lying in the hyperderm, which is margined from the surrounding tissue by a firm or delicate connective-tissue capsule and which gradually by its pressure leads to atrophy of the adjacent tissues or their constituents."

Epidermoids (4) of traumatic origin grow more slowly and are less in size than the congenital, as embryonal cells have a greater ability to grow.

Pietzner (3) found the period of time elapsing between the causative trauma and cyst development to vary from 1 month to 24 years.

Unna (1) notes the absence of microorganisms in epidermoids and states that the typical content of the epidermoids consists of concentrically arranged horny layers,

plates of cholesterin and débris of both constituents with frequent fragments of lime and pigment.

Toerrok (1) found by osmic acid tests, the absence of sebaceous cells and, almost invariably, of fats generally.

Ether (5) will not dissolve the material contained in epidermoids.

According to Buerger (3), desquamated horny epithelial cells, granular detritus, and at times cholesterin crystals fill the interior of these cysts. He says: "In short we have the usual elements of the epiderm surrounded with connective tissue but arranged in inverse order so that the stratum corneum is innermost and furnishes the material for the cyst content."

The walls of these cysts show some or all of the elements of the epiderm, and (3) are made up from without inward first of a layer of connective tissue, then of cuboidal and polygonal epithelial cells, which become gradually flattened in the succeeding layers, until finally the innermost stratum shows only cornified epithelium.

The presence of giant cells in the cyst wall are ascribed by Stewart (7) and Cederbaum (4) to irritation by the desquamated cell content. Other writers, notably Hildebrand (7) and Williamson (7), have claimed they were due to the presence of hairs. The cells are of the foreign-body type and are only found in the granulation-tissue-like layer which lines such portion of the cyst wall as is not made up of epiderm.

Different parts of the body are given by various authors as the most common site of epidermoids.

Bland-Sutton found them most frequently on the hands and fingers and is agreed with in this by most of those who hold to the traumatic origin of these cysts.

Pietzner (3) found that 68 out of 73 occurred on the hands.

Unna thinks they are most frequent in the hairy scalp.

Dubreuith reports 13 collected cases, following various kinds of trauma including surgical operations, on parts of the body other than the hands and fingers; the forehead, tongue, buttock, penis (congenital, and following circumcision), and toes (following operation for ingrowing toe-nail).

In the author's 11 cases and the 4 observed by Black, the cysts were found in the following positions: scalp, 4; back, 2. One each on shoulder, arm, cheek, lower jaw, neck, breast, groin, buttock, finger.

In two cases there were multiple cysts, the remainder were single.

Buerger (3) found most in men; Woerz (3) reports only 7 out of 53 in women; Pietzner (3) in 73 cases, 63 male, 10 female.

In the author's 11 cases, 5 were men, 6 women; Black's 4 cases, 2 men, 2 women.

Epidermoid cysts are differentiated from sebaceous cysts by the absence of an opening and by the difference in their contents. All sebaceous cysts show an opening in the skin and, without being pricked, discharge their contents from time to time, or may have their contents expressed and their shape changed or molded by external manipulation.

The absence of all micro-organisms separates epidermoids, together with dermoids, from follicular cysts. Unna (1) lays much weight on this fact as a means of differentiation in certain large atheroma-like follicular cysts. Closed or open cysts that have contents fatty or smelling of fatty acids are never epidermoids.

The pearly luster of the contents in epidermoids is one of their most noticeable and constant characteristics. Almost as constant is their laminated and flake-like appearance.

No attempt has been made to collect or tabulate the reports of cases from the literature. Various authors in their papers have duplicated the cases and several, Bland-Sutton (10), Pilliet (9), Dubreuith (6), Little (5), Buerger (3), Warner (8), Cederbaum (4), and others have reported cases of their own, some of which were diagnosed and others mistaken for other forms of growth until excised.

I have operated upon 11 cases of epidermoid cysts. These cysts varied from ½ inch in diameter to 1¾ by 1 inch in size. All except the three of traumatic origin had existed for years, or as the patients said, "as long as they remembered."

The traumatic cysts were operated upon 1, 1½, and 14 years, respectively, after the

occurrence of the trauma. The inducing trauma were splinter driven into skin, hat-pin puncture, and blow on groin.

The cysts have always shown as nodules, more or less hemispherical, projecting from the body surface, a few unattached to but the majority firmly fixed to and a part of the skin and freely movable as to the underlying tissues. The overlying skin has, with few exceptions, been firmly attached to the cyst for a considerable portion of its external surface. They were not flattened, as are sebaceous cysts, and, unlike the latter, could not be molded or changed as to shape.

None had any external opening or duct. Nor could any of their contents be expressed. One case had a small sebaceous cyst in the overlying skin, and the odorous sebaceous material which was expressed from it led to an incorrect pre-operative diagnosis of the main cyst the contents of which proved to be entirely different.

The majority of these cysts showed enlarged and dilated capillaries in the skin overlying the summit of the nodules. One of them showed this over the whole external surface of the tumor and the overlying skin was more pigmented than the surrounding surface.

Two of the traumatic cases (splinter and hat-pin) were infected, showing inflammation and suppuration at the time of excision. The contents of none were odorous as in most sebaceous cysts.

The contents varied in the different cysts, as to consistency and color. Some were softer and some darker than others but all showed the granular, scaly, and more or less laminated horny appearance, more or less markedly pearly and glistening in spots. Some of the harder and drier contents were decidedly laminated in nature and separated into scaly flakes, occasionally quite large in size.

The cyst walls were rather thick and firm in most of the cases, the inner surfaces pearly white, and some were so typical as to contents that a macroscopic diagnosis could be made, but others were only settled with the aid of the microscope. However, the final diagnosis was made by histological examination in every case.

Giant cells were found in only two or three instances and were distinctly of the foreign body type.

A résumé of the author's cases follows.

CASE 1. Miss E. B., age 20. A tumor the size of a hickory nut was present on posterior surface of left shoulder, over upper border of scapula. It had been present since early childhood. It was hard, firm, and intimately attached to skin. There were many distinctly dilated capillaries over the apex of the nodule. Pre-operative diagnosis, possible sarcoma of the skin.

CASE 2. Miss M. B. Sister of Case 1. A small hemispherical nodule was present on outer posterior aspect of left arm about 2 inches above elbow. This had been present as far back as patient could remember. It was excised to see if of the same nature as cyst in Case 1 and proved to be the same.

CASE 3. C. D., boy, age 14, had a small hard nodule over left side of lower jaw. It was freely movable; no history of trauma.

CASE 4. L. M., man, about 40, had six cysts on back between neck and buttocks. One other had previously been excised by another operator and called sebaceous. The six cysts ranged in size from ½ to 1 inch in diameter. Two of these cysts had markedly dilated capillaries present on the surface. All six were epidermoids and it is possible the seventh one was also epidermoid in nature.

CASE 5. F. K., boy, aged 12, had single cyst ½ by ¾ inch, on left cheek in parotid region, considered as a possible endothelioma before excision; no history of trauma.

CASE 6. P. H. S., man, age 50, had a single cyst on scalp with thick but fragile walls. It had been present for more than six years. It was pea-sized and movable, when first noticed. It grew slowly; no history of trauma.

CASE 7. J. F. H., man, age 62, had single cyst near nipple of left breast, at site of splinter penetration two years previously. One year later a lump appeared. He was operated upon 2 weeks after extrusion of piece of splinter associated with suppuration. The cyst was about ¾ inch in diameter, apparently in the skin, quite close to the nippel, but could not be definitely connected with the mammary gland. The whole breast was excised for fear of possible malignancy.

CASE 8. E. D., woman, age 60, had a single cystic mass involving the skin of the left groin well up toward the anterior superior spine of ilium. It was the size of a small hen's egg, slightly irregular in shape, had many enlarged capillaries on its surface, and was somewhat pigmented. Contents were distinctly yellowish in spots from cholesterin crystals. It had been present for over 10 years, appearing soon after accidental trauma, was opened and swabbed out some years after first appearance. It grew slowly and finally became sensitive to pressure of corset.

CASE 9. N. H., woman, age 22, had single cyst on back to left of mid-line, in lower dorsal region. It had been present for years. There were no enlarged capillaries on surface. It was supposed to be sebaceous cyst, but proved to be epidermoid on excision.

CASE 10. G. H., woman, age 42, had single cyst of scalp ¾ inch in diameter. Noticed 7 months prior to operation, following trauma by hat-pin, which had occurred 3 or 4 months before appearance of tumor. It was inflamed and suppurating at time of operation and the cyst wall was firmly adherent to surrounding tissue and came out piecemeal. Contents were laminated and horny. It was macroscopically an epidermoid.

CASE 11. J. R., woman, age 57, had three cysts on scalp, ½ to ¾ inch in diameter. She had had three others, one of which suppurated and discharged; the other two were removed by another operator and called sebaceous cysts. Of the three remaining cysts, two had been inflamed previously and were very adherent, the third shelled out easily. All three were epidermoids and it is most probable that the other three were of the same nature.

The four cases observed by Dr. Black were as follows:

CASE 1. Case of Dr. C. G. Toland. Woman, age 50, suffered crushing trauma of finger, 1 year previous to operation. There was no bleeding at time of injury, but intermittent swelling, with recent appearance of white spot, associated with pain. The cyst was removed and showed characteristics of epidermoid.

CASE 2. Case of Dr. L. B. Morton. Male, age 30, had cyst of gluteal region, size of small orange. There was no history of trauma. A cyst was present 9 years. It was excised after 2 years but reappeared. A second excision was done by Dr. Morton and the cyst did not recur.

CASE 3. Case of Dr. J. H. Forbes. Woman, age 58, had cyst 1½ inches in diameter on scalp to side of occiput, above neck. There was no history of trauma.

CASE 4. Case of Dr. Paul Ferrier. Male, age 50, had cyst on back of neck, to left of spine, the size of a lemon. It was not supposed to be traumatic. It had existed over 2 years, was inflamed, and had been lanced once. Contents were of foul odor, laminated, and pearly.

SUMMARY

Epidermoids are evidently of fairly frequent occurrence, but almost invariably unrecognized.

They are almost always mistaken for sebaceous cysts.

They may be either traumatic or embryonic in origin.

The pearly, horny, and laminated contents make their recognition easy.

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INTUSSUSCEPTION OF THE ILEUM IN ADULTS, DUE TO BENIGN TUMORS[1]

By M. H. BIGGS, M.D., F.A.C.S., Rutherfordton, North Carolina

MOST authorities are agreed that intussusception is the cause of more than one-third of all cases of intestinal obstruction, and that the majority of the cases occurs in childhood. The incidence of intussusception decreases as age increases, and cases occurring after middle life are apt to find their way into the literature.

Eliot and Corscaden (1) in a review of the subject of intussusception make the statement that while this condition in infants and children is carefully and exhaustively described in textbooks and in the literature, the consideration of the same lesion in adults is almost universally neglected.

The case here reported occurred in a man 49 years old. The intussusception was situated in the ileum and was caused by a myxoma, which is one of the rarest of benign growths found in the intestine.

There are many causes of intussusception and cases are reported in the literature as being due to diarrhœa and ulcerative conditions of the intestine, benign and malignant growths, Meckel's diverticulum, intestinal parasites, heavy lifting, trauma, and the use of purgatives.

In 1884, Treves (5), in a classic prize monograph, reviewed the subject of intussusception from every angle and stated that polypi of the intestine were present in 5 per cent of the cases, and called attention to the fact that the tumor is usually attached to the apex of the intussusceptum. Following this publication of Treves' monograph, several authors reported cases of intussusception of the small intestine due to tumors.

Histologically polypus, lipoma, myoadenoma, fibroma, myxofibroma, myofibroma, myxoma, cyst of the ileocæcal valve, and papilloma, are all mentioned among the benign tumors causing intussusception; and of the malignant tumors reported there are different varieties of carcinoma, sarcoma, myxosarcoma, melanotic sarcoma, and epithelioma. Considering the intestine as a whole, one-seventh of the cases of intussusception are due to malignant growths, while one-fifth are due to benign tumors. Of tumors of the large bowel causing this lesion the proportion between benign and malignant is about equal, while in the small intestine benign and malignant bear the relation of two to one.

CASE REPORT

Eight years ago. the patient, a male aged 49, had a severe attack of what was considered dysentery, when he passed a considerable quantity of blood and mucus. There was a period of 5 years of complete health when he began to have indigestion. This has persisted and has been accompanied by colic-like pain from 1 to 2 hours after taking food. This pain has increased markedly in frequency and severity and with it there has been passing nausea. Three days before operation there began severe general abdominal pain with nausea. The next day he began vomiting. The bowels did not move in spite of heavy administration of purgatives. Blood was not vomited nor defæcated at any time except during the supposed attack of dysentery.

When I first saw him the abdomen was much distended, he was becoming toxic and there was evident complete intestinal obstruction, and immediate operation was advised. At operation, through a right rectus incision. the ileum was found intussuscepted for a distance of 4 inches. The gut was angry looking and at the apex of the intussusception could be palpated a small mass. Reduction without traction was accomplished and the mass was determined to be a rounded tumor arising from the inner wall of the intestine and filling its lumen. The basilar attachment was too broad to admit of excision of the tumor alone, and enterectomy and vertical anastomosis were done. The patient made a smooth recovery and has reported himself several times as in complete health. The tumor and a portion of the the excised gut were sent to the surgical laboratory of Dr. Charles H. Frazier for examination.

Pathological report. Specimen consists of a portion of intestine measuring 7 centimeters in length. One margin is free, the opposite one is slightly infolded and the lumen is obstructed by a solid mass. On opening the bowel the growth is seen to be attached to one margin. The tumor measures 3.5 centimeters in length by 3 centimeters in width. It is covered by mucous membrane which is intact throughout. The tumor has caused almost complete obliteration of the intestinal lumen. On cross sec-

[1]Read before the North Carolina State Section, Clinical Congress of American College of Surgeons, Charlotte. North Carolina, January 23, 1921.

tion the mass is solid, homogeneous, and white in color.

Microscopic examination. Cross section through the tumor shows a mucous lining which is preserved in part, in many areas the glands have undergone destructive changes. In these situations there is much inflammatory reaction and the mucosa as well as the tissue beneath are infiltrated with leucocytes. There is a narrow band of tissue separating the mucosa from the underlying parts. The tissue here is composed of cells, spindle in shape, the nucleus taking a deep stain, the protoplasm drawn out forming interlacing fibrils, between which is a homogeneous material taking a faint blue stain. This tissue extends into the muscular coats separating and destroying the fibers, the individual fibers are seen traversing the myxomatous areas. Diagnosis: myxoma.

Practically no part of the intestinal tract is immune to intussusception due to or, at least, associated with tumor. Thompson (7) reports a case due to polypus of the pylorus, and Lane (8) one in which a benign tumor of the large intestine protruded from the anus.

It seems obvious that a larger proportion of benign than of malignant tumors produce intussusception in the small intestine. This is due to the fact that benign varieties are more prevalent in this location and also because they produce less alteration in the structure of the bowel; even when recurrently invaginated it is still comparatively soft and pliable. Malignancy, on the other hand, renders the bowel thicker, firmer, and more difficult to infold.

An epoch-making monograph on the subject of intussusception was published in 1898 by D'Arcy Power (2). This authority states that intussusception in children is nearly always spontaneous, and postmortem examination does not often reveal any definite cause for its occurrence, but that when it appears in an adult a determining cause can nearly always be found. In the adult it may be physiological, for the invagination may follow upon a direct injury to the abdomen, and in some cases it is as truly spontaneous as it is in children, but far more frequently the cause is some form of new-growth.

The most noteworthy contribution to this subject since Power's monograph is the splendid collective review of Eliot and Corscaden which I have taken the liberty to quote. They based their work entirely on the lesion in adults, and analyzed three hundred cases taken from the literature. In this series there were sixty instances of benign tumor, and forty instances of the malignant type associated with obstruction. Of the benign class the majority had their origin in the inner layers of the intestinal wall, usually by a constricted or pedunculated base, and projected into the lumen, thus forming a more natural nidus for irritation than the less frequent subserous growths that project into the peritoneal cavity. Illustrating the latter type Willard (3) has reported a very interesting case caused by a subperitoneal lipoma. Officer (4) has reported a case in which there were forty-one polypi of the intestinal tract which caused repeated intussusceptions.

This recurrence of intussusception is a phase of the subject that to me seems important. From a perusal of the literature of the cases operated upon I would say that many of the patients have been subjects of repeated invaginations in some degree. This seems borne out by the history over rather a prolonged period, and at times by the condition of the intestine when exposed. One can easily imagine tumors, such as the one present in my case, which fitted the bowel closely, becoming inflamed and engorged and in themselves totally obstructing the bowel, but one would not expect the short period of symptoms with sudden relief that these patients experienced.

Concerning the course and symptoms of these benign tumors of the small bowel, the first manifestation will probably be slight obturation, followed later by chronic stenosis and perhaps recurring intussusception, with the final development of complete obstruction. Early symptoms may be absent or slight and the patient may be suddenly stricken. More often the symptoms are progressive and vary with the location of the growth. The higher the situation of the tumor in the bowel, the later will be the development of symptoms, because of the fluid state of the intestinal content. Recurrent invagination is accompanied by colic-like pain, passing nausea, and sudden relief, and may be present at decreasing intervals for a prolonged period before obstruction results.

As to frequency, if we go to the autopsy table for information we find benign tumors of the small intestine much more common than the general literature would indicate. Willis (6) in a recent paper estimates it as nearly one in every four hundred autopsies.

Not every benign tumor causes intussusception, but it always has potential possibilities. Some cases will be free from symptoms until obstruction occurs, but if we bear in mind the possibility of the existence of tumor when dealing with obscure abdominal conditions it would seem that, in a certain number of cases, we should be able to make a diagnosis before total obstruction results. Certainly when operating for intussusception in an adult, if reduction is accomplished, we have not done a complete operation unless we search carefully for a co-existing tumor and remove it if present. If we fail to do this a recurrence of the intussusception is to be expected.

CONCLUSIONS

1 While intussusception is essentially a disease of childhood, it is found in adults with sufficient frequency to make it of surgical importance.

2. Intussusception in childhood is usually spontaneous. In intussusception in adults a demonstrable lesion can ordinarily be found.

3. The most common cause for intussusception in the small intestine in adults is a benign tumor.

4. Benign tumor of the intestine can often be diagnosed before obstruction occurs.

5. Recurrent invagination is often present previous to obstruction.

6. After surgical reduction of intussusception, tumor must be sought for and if one is present it must be removed in order to prevent recurrence.

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SUBDIAPHRAGMATIC ABSCESS

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SUBDIAPHRAGMATIC or subphrenic abscess may be defined as a collection of pus beneath the diaphragm, but in direct contact with it.

Barlow, in 1845, described the condition, Hilton Fagge, in 1873, and 1874, published some interesting observations on it, but it was not until 1879 that the first operation was recorded by von Volkmann.

It is necessary to have a clear mental picture of the anatomical boundaries of the subphrenic space in order to appreciate the possible etiological factors and the sequelæ of an abscess located in this region. An exact knowledge of the anatomy of the space is also important in determining the nature of the operation necessary to insure the easiest access to the abscess and its complete drainage. The textbook descriptions of the anatomical boundaries and of the extent and route of extension of subphrenic abscesses are vague and indefinite. Barnard's detailed description of the space is probably the most complete for practical purposes; however, it is somewhat illogical and not altogether anatomically correct. He describes six areas on the under surface of the diaphragm; four intraperitoneal and two extraperitoneal. The four intraperitoneal spaces are separated and defined by the cruciform arrangement of the peritoneal folds or ligaments of the liver, namely: the falciform, the coronary, and the right and left lateral ligaments. The right extraperitoneal subphrenic space occupies the uncovered area between the layers of the coronary ligament as they are reflected onto the diaphragm, while the left extraperitoneal space is described as the area above the pole of the left kidney where the peritoneum reflects on to the diaphragm.

The peritoneal cavity may be divided into supracolic and infracolic portions, the former being the portion above the transverse colon and the latter the portion below. The supracolic area is divided by the falciform ligament into a right and left portion, and these are again divided transversely by the coronary ligament and the right and left lateral ligaments to form four areas: (1) the right anterior intraperitoneal, (2) the right posterior intraperitoneal, (3) the left anterior intraperitoneal, and (4) the left posterior intraperitoneal (Fig. 1).

In the right anterior intraperitoneal space, described by Barnard, the convexity of the liver is below and the corresponding concavity of the diaphragm is above. The falciform ligament forms its medial boundary and behind passes to the right lateral ligament of the liver. If an abscess forms in this space, it is shut off from the peritoneal cavity in front by a variable line of adhesions, usually of the transverse colon and omentum if the etiology is perforating gastric ulcer or duodenal ulcer, but if the etiology is an inflammatory extension from behind or from within the liver, the anterior border of the liver becomes adherent to the diaphragm and itself forms the lower boundary. The right anterior intraperitoneal cavity has important connections. At its posterior and outer part it communicates around the margin of the liver and around the extremity of the right lateral ligament with the right posterior intraperitoneal cavity, or the subhepatic pouch (Morison). At the same point it is directly continuous with the right lumbar fossa or right paracolic groove which lies between the ascending colon and loin, and extends down to the cæcum and thence into the pelvis. Because of its location and free connection with adjacent fossæ, an abscess develops more frequently in this space than in any of the other subphrenic areas. This space is in reality the only true subphrenic space on the right side, and it is questionable if it should not be classified as the right subphrenic space.

The right posterior intraperitoneal space is an irregular pyramid-shaped area extending transversely beneath the overhanging margin of the liver. It is bounded laterally by the wall of the abdomen, anteriorly by the liver and gall-bladder, and posteriorly by the upper

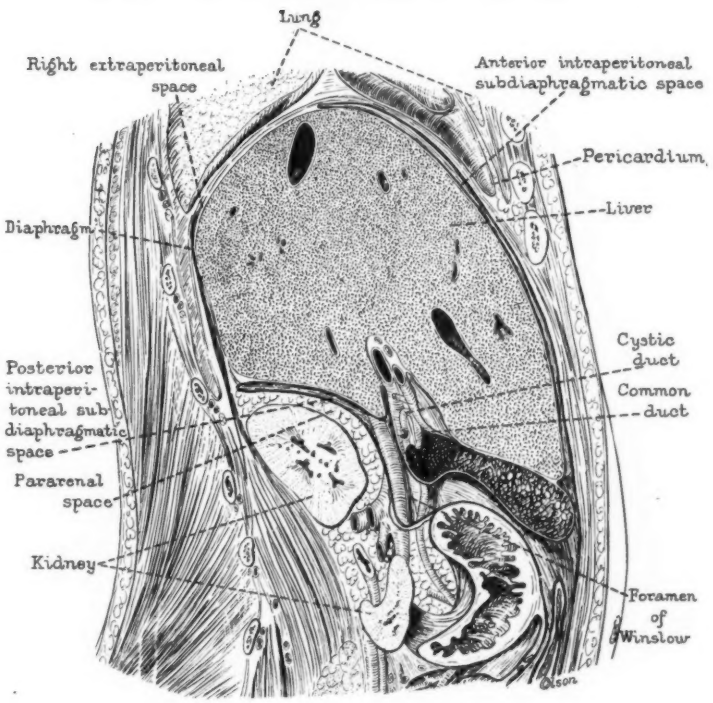

Fig. 1. Diagrammatic longitudinal section showing the relations about the diaphragm on the right.

pole of the kidney and crus of the diaphragm; medially the apex is formed by the sloping margin of the left lobe of the liver and by the common bile duct and duodenum. Here it connects through the foramen of Winslow with the left posterior intraperitoneal space (the lesser peritoneal cavity). Above, to the right, is the right lateral ligament and the liver, and medially (left) the transverse fissure.

If an abscess forms in this area it is walled off below by adhesions between the margin of the liver and the surface of the stomach medially, and below and laterally by adhesions of the great omentum and transverse colon to the margin of the liver and the anterior and lateral abdominal wall. This space is continuous laterally with the right lumbar pouch or paracolic groove and with the right anterior subphrenic space. It connects through the foramen of Winslow with the left posterior intraperitoneal space, but usually this opening seals off early in the presence of inflammation. The area is but feebly shut off from the left anterior subphrenic space. This space lies at a lower level and is not strictly posterior to the right anterior intraperitoneal space. It is certainly more descriptive to speak of it as the right kidney pouch (Morison) or the subhepatic fossa (Cantlie).

The left anterior intraperitoneal space occupies the so-called dome of the stomach's chamber, and an abscess in this area is often spoken of as perigastric or perisplenic. It is bounded above by the diaphragm; medially (right), by the left lobe of the liver, the falciform ligament and the reflection of peritoneum forming the gastrohepatic ligament; laterally (left), by the spleen, the gastrosplenic ligament, and the abdominal wall, and extends as far back as the left lateral ligament of the liver. Adhesions of the anterior surface of

TABLE I.—PRIMARY LESIONS

	Cases	Stomach	Duodenum	Liver and Gall-Bladder	Thorax	Appendix	Focal
Barnard's	76	21	5	15	9	12	
Mayo Clinic	100	12	10	33		22	16
Finkelstein	252	67 (26.6 per cent)					
Lance	943					222	
Piquand	890					191	
Maydl	179	20 per cent				50 (23.3 per cent)	
Perutz	214	70 (32.7 per cent)					
Cases collected by Archibald	448				18		

TABLE II.—SUBPHRENIC ABSCESS OF APPENDICEAL ORIGIN

	Cases
Collected	20 primary or pre-operative 17 early postoperative 3 late postoperative
Sonnenberg's Clinic	9 (of 600 cases of appendicitis)
Ross	30 (0.8 per cent of 3391 cases of appendicitis)
Treves	6 (of 1000 cases of appendicitis)
Kelly and Hurdon	7 (in 410 consecutive necropsies)

Subphrenic abscess develops in 0.6 to 1 per cent of all cases of appendicitis.

the stomach and great omentum to the abdominal wall limit it below if an abscess forms. The floor of the space is formed by the anterior surface of the cardiac end of the stomach, the spleen, the left kidney, the adrenal, and the tail of the pancreas. The boundaries of this space are extremely variable. It is but lightly shut off medially from the right posterior intraperitoneal space and laterally is continuous with the left lumbar fossa or paracolic groove. It is the true subphrenic space on the left.

The left posterior intraperitoneal space is merely that contained in the lesser sac of peritoneum. The liver, lesser omentum, and posterior wall of the stomach bound it anteriorly; the left crus of the diaphragm, the pancreas, and the upper part of the left kidney and suprarenal bound it posteriorly. Laterally there is one surface of the spleen, below is the transverse colon, and medially or to the right is the duodenum and the hepatic artery, portal vein, and bile ducts with the posterior surface of a gastrohepatic fold of peritoneum, forming the anterior wall of the foramen of Winslow, through which the space connects with the right posterior intraperitoneal space. This cavity is not directly posterior to the left anterior intraperitoneal space, and it is more descriptive to speak of it as an abscess in the lesser sac.

ETIOLOGY

Subphrenic abscesses are due to many causes, and the location of the abscess or abscesses depends usually on the primary etiological factor. The abscess may result from direct infection or soiling, or from a pyogenic infection borne to the area from a focus elsewhere. Approximately two-thirds are the result of soiling from a viscus within the abdomen, either before or following operation; one-sixth are the result of extension from an adjacent abscess (such as a perinephritic abscess); and one-sixth are the result of distant foci of infection. A high percentage of these abscesses follow an abdominal operation. Undoubtedly gravity plays an important part in the selection of one of the subphrenic spaces for the development of an abscess, particularly postoperatively. In an examination of the abdomen, the posterior abdominal wall is seen to be divided by the vertebræ into two deep gutters. These

are divided transversely into the subphrenic pouches above, and are separated by the muscles of the loin, the kidney, and the pararenal fat, from the pelvic cavity below. If a patient is confined to bed by any condition which produces fluid within the peritoneal cavity, and is not in the partial sitting posture, fluid tends to accumulate in the subphrenic areas instead of flowing down over the lumbar elevations into the pelvis where absorption is not so rapid, where abscesses are not so prone to develop and where if they do develop, they can be more easily dealt with, at least in the female. Undoubtedly, subphrenic abscesses are more common in males than in females, possibly because the anatomical variations between the pelvis of the male and female allows the paracolic grooves to drain more readily into the pelvis of the female than the male. In 113 patients observed in the Clinic, 84 were males and 29 were females.

Subphrenic abscesses are due to the perforation of a hollow viscus within the abdomen, such as perforating gastric ulcer or duodenal ulcer, appendicitis, infected gallbladder, abscess of the liver, kidney, spleen, or pancreas, traumatism, peri-œsophageal suppuration, degenerating carcinoma, infected spinal abscess, affections of the ribs, pyæmia, pneumonia, empyema, lung abscess and distant foci of infection, such as carbuncles, cellulitis, and so forth.

With the suspensory ligament as the dividing line, abscesses of hepatic, appendiceal, or duodenal origin usually form to the right; those from perforation of the stomach, or infections of the spleen and pancreas, are to be found to the left. It is surprising, however, that so many left-sided abscesses are of appendiceal origin.

Perforating ulcers of the anterior wall and greater curvature of the stomach are more likely to cause localized or general peritonitis than those of the lesser curvature and posterior surface, which tend to the formation of subphrenic abscess. In 76 cases reported by Barnard, 21 were due to gastric ulcer and 5 to duodenal ulcer. Among 252 cases reported by Finkelstein, 67 (2.6 per cent) were due to lesions of the stomach. Of 100 cases in the Clinic, in which the etiology was fairly definite, there were 3 due to carcinoma of the stomach, 9 to gastric ulcer, and 10 to duodenal ulcer (Table I).

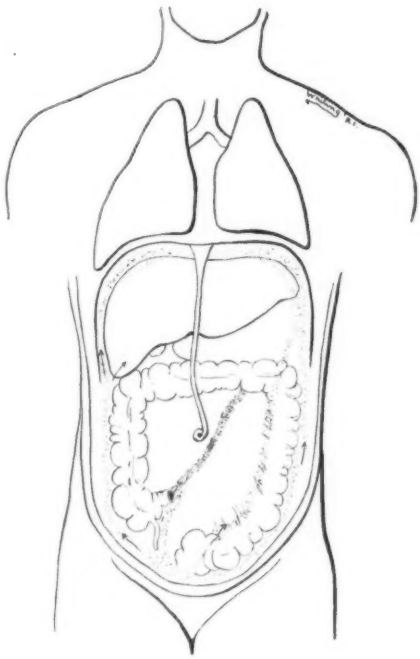

Fig. 2. Diagrammatic illustration of lymph channels.

Subphrenic abscess is too commonly of appendiceal origin. It occurs usually in a gangrenous, retrocæcal, or highly placed appendix. Undoubtedly, it was a more common sequela of acute appendicitis when patients did not come to operation as early as they do now and when drainage was more generally practiced, and especially in patients in whom drainage merely was instituted, and the appendix left to be removed later (Table II). The mode of the spread of infection to subphrenic areas is by—

1. Direct extension by gravitation from a general or adjacent localized peritonitis.
2. Direct extension from the lower peritoneal fossa (pelvic cavity).
3. The portal vein.
4. Lymphatics.
   a. From the right retroperitoneal cellular tissue.

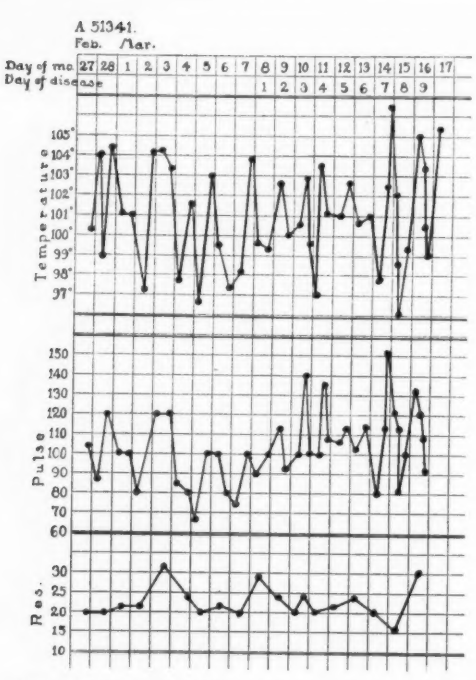

Fig. 3 (51341). Subphrenic abscess following cholecystostomy. Acute course in a very acute exacerbation and death. Note the very high temperature with accompanying pulse.

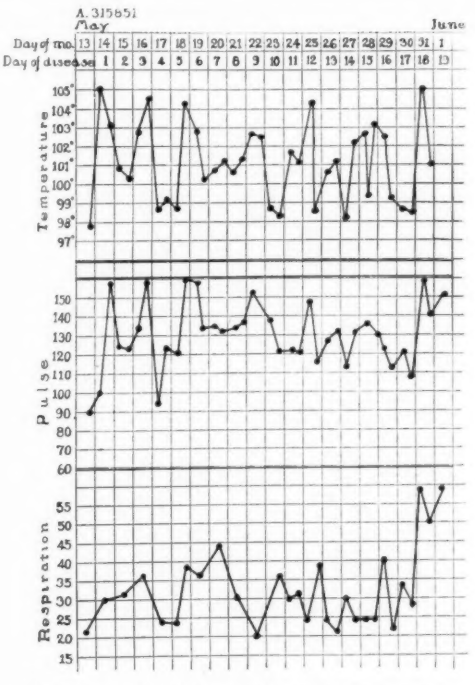

Fig. 4 (315851). Subphrenic abscess following empyema. Note the marked variation in temperature, pulse and respiration with infection localized to diaphragm in this case, above and below.

b. From around the deep epigastric artery to the falciform ligament (Barnard). The lymphatics of the appendix, those of the ileocolic juncture, and those of the ascending colon are closely associated.

c. From the subphrenic lymph plexus which communicates through the lymph vessels which pierce the diaphragm, with the subpleural plexus on its superior surface; thereby with pus under tension infection may spread in either way (Fig. 2).

5. General infection through the blood stream.

The organisms usually found in subphrenic abscesses are *bacillus coli* associated frequently with streptococci or various types of anaerobes.

The content of a subphrenic abscess varies with the etiology and may consist of caseous débris, bile, liver cells, ecchinococcus cysts, carious bone, and occasionally of gastric or duodenal contents.

The pathological process is infection, liquefaction, necrosis and pus, the reaction forming a granulating protective tissue barrier. It requires apparently about 2 weeks for the abscess to wall off; therefore, earlier transpleural drainage should not be considered. Usually the perforation in the wall of the stomach or duodenum closes spontaneously with the development of the abscess, and a permanent fistula is rare. Gas, which is present in approximately one-third of all cases, is due either to an anaerobic infection, or, more rarely, to direct connection from intestine or stomach. The abscess may be unilocular or multilocular.

SYMPTOMS

The symptoms of subphrenic abscess vary with the etiology, with the location of the abscess, and with the general resistance of the

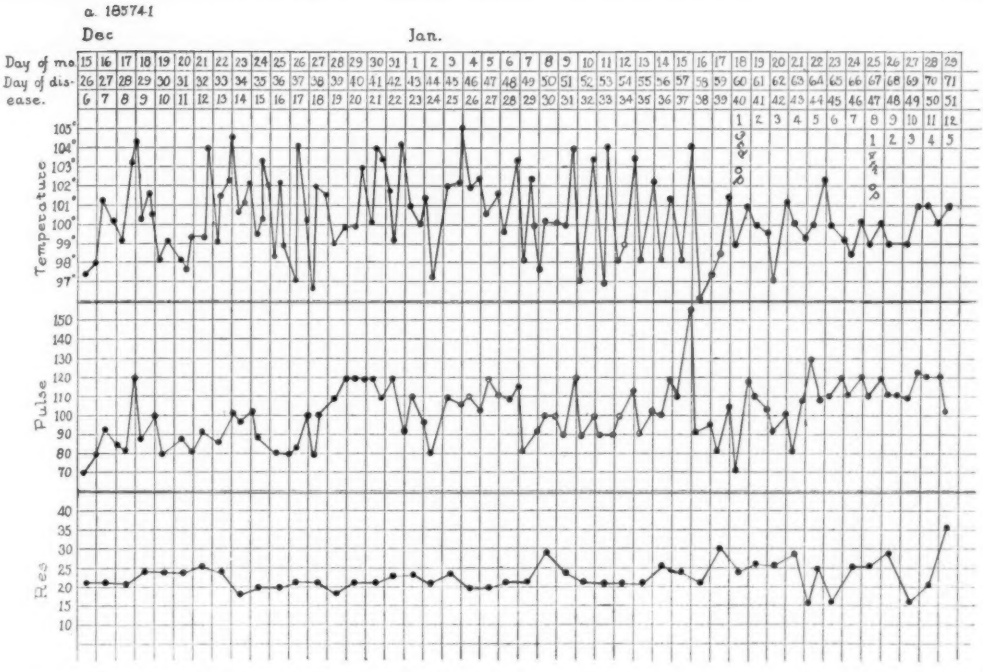

Fig. 5 (185741). Subphrenic abscess following drainage of appendiceal abscess. Note the very long course of disease, 71 days, with high temperature but little respiratory change; eventual recovery.

patient. They also vary with the onset of the disease, whether it is acute, insidious, or insidious with an acute exacerbation.

As the condition, in more than two-thirds of the cases, follows an abdominal operation, it should be suspected at once in a patient who maintains, for no obvious reason, an elevation of temperature and pulse after such an operation.

A long history of duodenal ulcer or gastric ulcer, or repeated attacks of cholecystitis or of appendicitis should lead to the suspicion of abscess in patients not operated on. The most constant symptoms are:

Varying degrees of temperature, usually showing a marked variation (the church steeple type), with a corresponding increase in the pulse rate. The respiratory rate rarely follows the temperature pulse curve. The temperature and pulse curves, especially if associated with a chill, are practically always diagnostic of inflammation around the diaphragmatic level (Figs. 3, 4, and 5).

Pain at the costal margin referred also to the back and frequently to the shoulder area. Deep pain can usually be elicited by pressure over the costal margin from the front to the back or from side to side.

The leucocyte count varies; it is usually high in acute cases. Occasionally a leucopænia is found, and in such cases the abscesses are of the insidious type, and had formed some time before the patients came under observation, or in a small percentage of cases, when the patients were in an advanced state of emaciation and generally lowered resistance. Sweating occurs. Rigors are common at some stages. A short catchy diaphragmatic cough is often present. Dyspnœa is observed occasionally. Vomiting and hiccough occur at some stage in about 50 per cent of the cases. Emaciation and weight loss is progressive in practically all cases. Inspection in approximately 60 per cent of the cases reveals a mass or bulging either in front, laterally, or posteriorly at the transcostal

TABLE III.—FACTORS DIFFERENTIATING SUBPHRENIC ABSCESS, PLEURISY WITH EFFUSION, AND ABSCESS OF THE LIVER

Subphrenic Abscess	Pleurisy with Effusion	Abscess of the Liver
Postoperative abdominal sequelæ, or prolonged intra-abdominal or inflammatory focus elsewhere	More common following influenza, pneumonia, and exposure to colds, and so forth	A history of dysentery (amœbic). Usually blood infection
Temperature of church steeple type, associated with rigors and sweating	Temperature may be high at first, also with rigors, but not so often of the church steeple type and the respirations are usually rapid	Temperature and pulse curve much the same during the suppuration stage, but not early in the disease. Respiration not often increased
Breath sounds well into the dull or tympanitic area of the abscess	Breath sounds cease abruptly	Less marked extension of dullness upward
Little variation in the fluid level, unless gas is present; then usually succussion splash	Level varies with the position of the patient	
Heart rarely displaced. Dyspnœa and cyanosis rare	Heart frequently displaced. Dyspnœa and cyanosis common	
Liver usually pushed down without being enlarged	Occasionally rotated downward and outward	Liver enlarged and tender
Icterus occasionally when the abscess has ruptured through the liver capsule and into the bile canalicu'i	None	Icterus not common, but a peculiar greenish yellow tint to the skin
Diaphragm high	Diaphragm low	Diaphragm may be high, but irregular

plane. The abdominal thoracic movement is usually limited on the affected side, and, particularly in the early cases, the interspaces directly over the abscess are frequently retracted. The latter sign is valuable in the early questionable cases. Further physical examination reveals a limitation of the diaphragmatic excursion, and some elevation on the affected side. The liver may be pushed down, and the stomach may be displaced downward or forward. Very often there are signs suggestive of a basal intrathoracic involvement, such as dullness on percussion, and diminished breath sound and fremitus. Occasionally pleural friction sounds are heard; they are probably present in all cases at some time during the development of the abscess, but are not always recognized, since the pleuritis or perihepatitis resolves speedily. Careful physical examination reveals a different picture as the abscess develops. The friction rub may persist or disappear. As the abscess extends there is an increasing area of dullness, and in percussing down the back normal resonance is usually elicited, then increasing dullness due to compression of the lung only; then dullness due to a collection of pus, or, if there is gas in the abscess, a variable area of hyporesonance, and then absolute dullness that may or may not merge into the liver dullness. At times there is a coin sound over the stomach that is transmitted through the abscess to the dull area. The succussion splash, or *bruit d'airian*, may be heard over the area of hyporesonance, if the patient is rolled from side to side.

Although the presence of gas in subphrenic abscesses was recognized by Barlow and although Fagge had described it, it was not until von Leyden published his classical paper on "Subphrenic Pyopneumothorax Abscess" in 1880 that it was generally recognized.

ROENTGEN-RAY FINDINGS

Probably the most valuable aid in the diagnosis of subphrenic abscess is the roentgen ray. In early cases, or in extraperitoneal abscess, or in the right posterior intraperitoneal abscess, the diaphragm may be only slightly elevated, but may show a fairly characteristic irregularity. On the other hand, the diaphragm may be as high as the third or fourth space and absolutely regular in outline. In the usual picture the diaphragm is raised to the

TABLE IV.—MORTALITY IN GROUPS OF CASES OF SUBPHRENIC ABSCESS

	Patients with subphrenic abscess	Patients operated on	Deaths	Patients not operated on	Deaths
Barnard	76	64 (73 operations)	24 (37.5 per cent)	12	12
Michel and Gross	44	19	9 (47.3 per cent)	25	25
Eisendrath	106	84	23 (27.3 per cent)	22	18 (82.0 per cent)
Sachs	15.3 per cent 50 per cent	during first three weeks after first three weeks	37.5 per cent		
Lang	176	52.1 per cent		87.7 per cent	
Maydl		35.7 per cent	56 per cent		
Elsberg		22 per cent	40 per cent		
Sonnenberg			42 per cent		
Mayo Clinic	113	81	27 (33.3 per cent)	32	31 (96.8 per cent)

fourth space, and shows some cupping. The lung is not collapsed, but is merely pushed up. The outline of the diaphragm is more uniform than in cases in which the diaphragm is elevated by an abscess of the liver. The line of the diaphragm is more irregular when it has been caught up by an old pleuritis or by a partial collapse of the lung. Gas can usually be discovered by the roentgenogram, and gas and fluid by the fluoroscope. With fluid in the pleural cavity the diaphragm is usually low; it is irregularly high from an early pleuritis, and the fluid is a later development. In such cases, however, the costophrenic angle is generally blotted out, whereas in subphrenic abscess one or both angles are often clear. The degree of movement of the diaphragm can be accurately determined only by the fluoroscope. Full sized stereoscopic plates and thorough fluoroscopic examination are essential in the diagnosis of these cases (Figs. 6 and 7).

The differential diagnosis of subphrenic abscess usually lies between pleurisy with effusion and abscess of the liver, but perinephritic abscess, hypernephroma, cysts, and aneurism of the lower thorax or upper abdominal aorta, must also be considered. The clinical history of the condition is the most valuable feature in the differential diagnosis, and if carefully obtained, associated with the X-ray findings, and exploration with the needle, should clearly determine the site of the abscess. However, certain factors help to differentiate subphrenic abscess, pleurisy with effusion, and abscess of the liver (Table III).

It is not an easy matter, before operation, to determine the exact site of the abscess. Certain of the symptoms are common to all subphrenic abscesses; but others should clearly suggest the localization of the infection. Pain varies with the position of the abscess. Epigastric pain with bulging or a palpable mass in the epigastrium points to a left anterior or posterior subphrenic abscess, and an easily palpable mass in the epigastrium associated with pain is more commonly due to a left anterior intraperitoneal abscess than to a left posterior intraperitoneal abscess. Bulging from the middle axillary plane forward along the subcostal plane is more common with a right anterior intraperitoneal abscess than with a right posterior intraperitoneal, or a right extraperitoneal abscess. The pain accompanying the right posterior intraperitoneal abscess is deep, and more of an ache, and the pain with a right or left extraperitoneal abscess is usually more acute and the area over it is more tender than with intraperitoneal abscess. The febrile reaction is usually not so acute in the extraperitoneal types as in the intraperitoneal, also, the leucocytosis is not so high. Focal infections and lesions of the kidney more often produce extraperitoneal than intraperitoneal abscesses, whereas intraperitoneal abscesses usually come from an intra-abdominal cause.

The position of the liver is not altered by a left extraperitoneal abscess and often not greatly altered by a right extraperitoneal abscess. The right anterior intraperitoneal abscess usually pushes the liver down, whereas

TABLE V.—EIGHTY-TWO CASES DIAGNOSED SUBPHRENIC ABSCESS

Males 66, females 16	82
Males died	23
Females died	4
Longest time after operation 20 months	
Shortest time after operation 1 day	
Average time after operation 84 days	
Age less than 11	0
Age from 11 to 20	2
Age from 21 to 30	17
Age from 31 to 40	23
Age from 41 to 50	13
Age from 51 to 60	19
Age more than 60	8
Highest leucocyte count	47,700
Lowest leucocyte count	5,200
Average leucocyte count	17,300
Leucopænia (leucocytes below 8,000)	4 cases
Marked variation in leucocyte count	
Case 191574 (acute, 1 week)	from 11,000 to 29,000
Case 262217 (time not given)	from 9,0 0 to 26,000
Case 281706 (insidious onset)	from 12,600 to 47,000
Case 309608 (in 1¼ years)	from 9,400 to 21,000
Case 192433 (acute, 10 days)	from 15,400 to 34,800
Case 125446 (death in 9 weeks)	from 15,000 to 24,300
Highest weight loss	96 pounds
Lowest weight loss	10 pounds
Average weight loss	33 pounds

Average duration of symptoms 4½ months.

TABLE VI.—SUBDIAPHRAGMATIC ABSCESSES FOUND AT NECROPSY: THIRTY-ONE CASES

Males....18	Leucocytosis
Females..13	Lowest count....8,200
Age	Highest count....42,000
Under 11.. 0	(varied from 14,800; onset of disease insidious; patient died in 39 days)
11 to 20.. 1	Average count....17,400
21 to 30... 0	
31 to 40... 5	
41 to 50... 8	Time between final operation and death
51 to 60...11	Shortest.... 9 days
Over 60.. 6	Longest....63 days
31	Average....22 days

the right posterior intraperitoneal abscess may not greatly alter the position of the liver and may even push it up. The etiology, the nature and location of the pain, the tenderness, and the position of the mass, if present, serve fairly clearly to determine the position of the abscess. In considering the location, it must, as previously pointed out, be borne in mind that with the suspensory ligament as the dividing line, abscess of hepatic, appendiceal, or duodenal origin usually forms to the right, and one from perforation of the stomach, or from infection of the spleen and pancreas, forms to the left. Although the majority of these abscesses are probably single at first, frequently in late cases they are multiple, and a single abscess is very often multilocular.

COURSE AND COMPLICATIONS

The abscesses may resolve, or may burst into the lungs, into the pericardium, into the stomach and be vomited, into the colon or duodenum and be evacuated in the stool, or through the skin anteriorly; or they may perforate into the retroperitoneal tissue and burrow extensively, even reaching the posterior cul-de-sac in the pelvis.

It is difficult to know what percentage of subphrenic abscesses resolve and are absorbed. Resolution may occur early in certain cases that are in the more or less potential abscess formation stage. In those that have developed sufficiently to be recognized by the general group of symptoms, it is rare to see resolution and absorption. Thoracic complications, such as pleurisy, empyema, abscess of the lung, bronchial fistula, pericarditis, mediastinitis, and so forth, develop in a fairly high percentage of protracted cases. In 56 of 76 of Barnard's cases, there were thoracic signs, and in 140 of 173 cases (82 per cent) collected by Laing.

Rupture of the abscess through the diaphragm into the lung is not uncommon. Within the last year I have seen one following a gastric ulcer that perforated through the diaphragm into the lung. The contents were spat up and the patient recovered without interference. I have seen one case recently in which bilateral subphrenic abscesses, both apparently extraperitoneal, ruptured through the diaphragm on both sides into the lungs, and the contents were spat up. A third case was observed in which a subphrenic abscess, due to a degenerating hydatid cyst of the liver, also ruptured through the diaphragm into the bronchus, and pus with small daughter cysts in it was spat up.

Although rupture into the stomach is fairly common, rupture into the intestine is rare. This can readily be understood as the intestine seldom comes in contact with the abscess, either the stomach or liver interven-

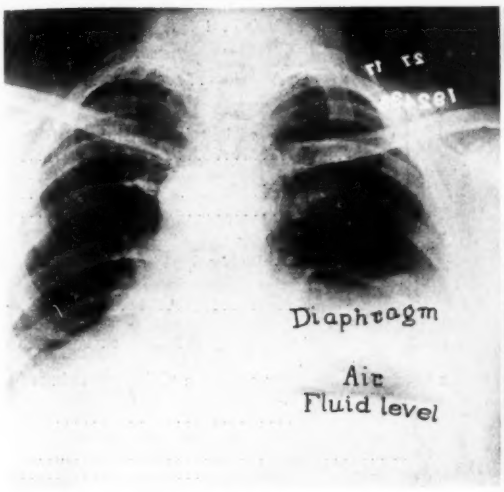

Fig. 6 (192433). Subdiaphragmatic abscess.

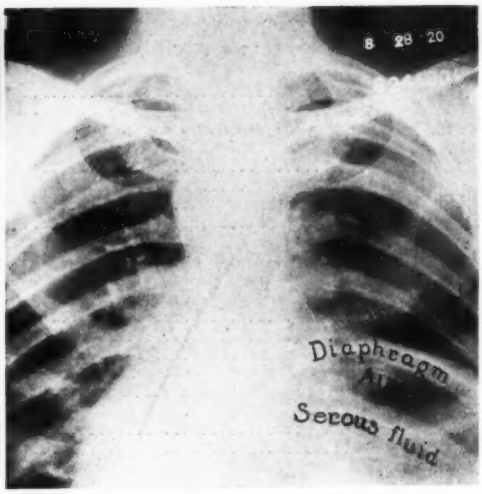

Fig. 7 (324430). Subdiaphragmatic abscess.

ing. The dread of these abscesses rupturing into the general peritoneal cavity and "lighting up" peritonitis is unwarranted, as this is extraordinarily rare.

On the whole, in less than one-third of the neglected cases, the abscesses either resolve or open spontaneously. Death occurs from toxæmia and the general weakness and inanition.

PROGNOSIS AND MORTALITY

The prognosis in these cases must be guarded, and this again depends on the duration of the abscess, the etiology, the location, and the general resistance of the patient. Between 85 and 100 per cent of all patients not operated on die. Death has been reported in approximately 56 per cent of all patients operated on and not operated on. From 23 to 40 per cent of those operated on have died. The mortality rate should be approximately 16 per cent. A small percentage have died during operation or within a few hours after, probably because of extreme weakness before coming to operation. The greater number of deaths after operation, however, has been due to incomplete drainage of the abscess. A certain percentage of deaths is inevitable because the patient with this type of disease frequently comes to the surgeon too late, and in spite of complete drainage of the abscess, the general infection causes death.

Careful necropsies and a study of necropsy findings have established beyond doubt that in the great majority of fatal cases, in which operation was performed, drainage was incomplete. At operation there has not been sufficient exposure of the abscess to reach all its ramifications. Very often a second abscess has been entirely overlooked; not infrequently the abscess was not located at operation (Table IV).

TREATMENT

The treatment of subphrenic abscess, when recognized, has been operative. The operation generally practiced has been either transpleural with resection of the eighth, ninth, or tenth ribs, or the surgeon has approached the abscess by an abdominal incision. The abdominal route is necessary for the left interior intraperitoneal abscess, and for the left posterior intraperitoneal abscess, but the latter should be approached only from in front and drainage established from behind.

The extraperitoneal abscesses and both right intraperitoneal abscesses can best be dealt with through a lateral thoracic incision. There are certain objections to the old operation of rib resection, namely, unneces-

TABLE VII.—ETIOLOGY IN EIGHTY-TWO CASES DIAGNOSED SUBPHRENIC ABSCESS

	Cases
Diseased appendices	19
Longest duration of symptoms 2 years.	
Shortest duration of symptoms 6 weeks.	
Average time of onset 10 months.	
Drained	11
Gangrenous, removed	2
Gangrenous, no operation	1
Diseased gall-bladders	23
Longest duration of symptoms 3 years.	
Shortest duration of symptoms 3 weeks.	
Average time of onset 10 months.	
Empyema of gall-bladder	3
Ruptured	4
Malignant	1
Perforated duodenal ulcers	6
Longest duration of symptoms 2 years.	
Shortest duration of symptoms 2 weeks.	
Average time of onset 5 months.	
No operation	1
Gastric ulcers	5
Longest duration of symptoms 3 years.	
Shortest duration of symptoms 6 days.	
Average time of onset 10 months.	
Cancer of stomach (time of onset 3 months)	1
Hydatid cyst (time of onset not given)	1
Colectomy (time of onset 4 weeks)	1
Focal infections	12
Prostatectomy, 1 month before coming to Clinic.	1
Tonsillectomy, followed by pyæmia, 6 months before coming to Clinic	1
Amputated leg, gangrenous, time not given	1
Carbuncle, 1 month before coming to Clinic	1
Pneumonia with pleurisy, time not given	2
Influenza, 3 weeks to 2 years before coming to Clinic	3
Mediastinal abscess, 3 weeks before coming to Clinic	1
Abscess of abdominal wall following removal of bladder stone, 2 months before coming to Clinic	1
Perinephritic abscess, 8 weeks before coming to Clinic	1
Miscellaneous (not clearly determined)	13

sary mutilation of the bony wall of the chest and tying off intercostal vessels, injury to the intercostal nerves, and so forth. Few surgeons are bold enough to take out sufficient rib (from 10 cm. to 15 cm.) to permit thorough inspection of the subphrenic spaces, or to allow thorough and complete drainage subsequently. Osteomyelitis and periosteitis frequently develop in the remaining portions of the rib, establishing chronic fistulæ which are usually extremely difficult to cure by any means. Particularly in well developed and fleshy patients the ordinary incision exposes large, fresh muscle surfaces, and fascial planes and fat for the absorption of the pus. Many of these patients show an intense reaction to this source of toxic absorption.

TABLE VIII.—ETIOLOGY IN THIRTY-ONE CASES

	Cases
Posterior gastro-enterostomies	6
4 duodenal ulcers.	
2 gastric ulcers.	
Pyloric resections (one patient had cholecystectomy for stones)	2
Nephrectomy (patient also had duodenal fistula)	1
Anterior Pólya for gastric ulcer	1
Cholecystectomies	6
1 patient had herniotomy and excision of duodenal ulcer.	
4 patients had appendectomies.	
1 patient had posterior gastro-enterostomy.	
Choledochotomies	4
1 patient had cholecystectomy.	
1 patient had cholecystostomy and an acute condition of the appendix.	
1 patient had an acute condition of the appendix and a right salpingitis.	
Second-stage Kraske	1
Cæcostomy for acute obstruction. Mikulicz 1 month later	1
Subacute retrocæcal appendix	1
Empyema (abscess)	1
Ascites (later splenectomy)	1
Burns, with multiple abscesses	1
Perforation of large bowel	1
Unresolved pneumonia	2
Prostatectomy	1
Abscess of the appendix (patient had ruptured pus tube with drainage)	1

Three patients had acute appendicitis with retrocæcal abscesses that probably extended to produce right posterior intraperitoneal abscesses.

In view of the foregoing objections to the old operation, and particularly since the cause of death is, as stated, incomplete drainage, or the overlooking of other abscesses, I have employed for 5 years, in abscesses located on the right side, the operation which in detail is as follows.

TECHNIQUE OF OPERATION

After the abscess has been located as accurately as possible, the height of the diaphragm and the extent of its lateral attachment are noted; the incision is planned for either the ninth, tenth, or eleventh right intercostal space. The patient is given one ampule of pantopon and scopolamine 1½ hours before operation and one-half of an ampule of pantopon (Roche) 45 minutes later. Paravertebral anæsthesia with 1 per cent novocaine is employed and the nerves are injected two spaces above and below the space to be incised. Gas and oxygen are at hand if the patient unduly complains during the manip-

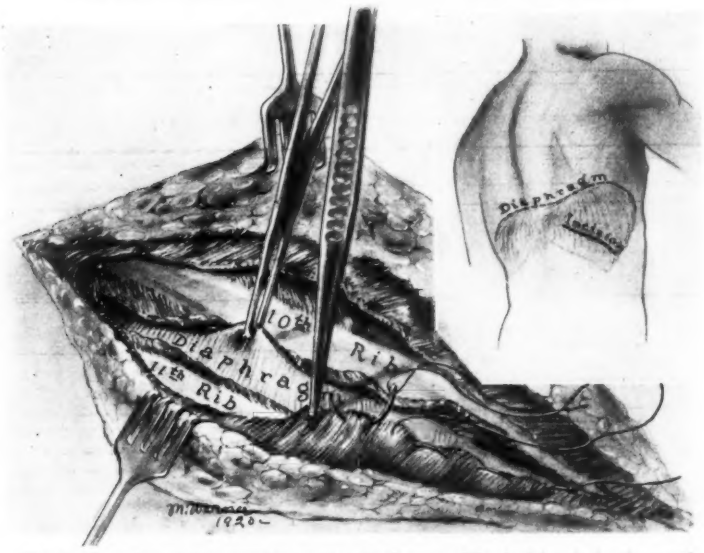

Fig. 8. Suturing of the muscles to the diaphragm. The incision is in the tenth interspace.

ulations within the abscess. An incision is made in the skin, from 16 to 20 centimeters in length, directly over the interspace and over the area of bulging, if present; otherwise it extends from the middle or posterior axillary line forward. The skin is undermined for from 3.75 to 5 centimeters back from the incision. The incision through the intercostal muscles passes about 1 centimeter above the upper border of the lower rib, so that no intercostal vessels or nerves are involved. The parietal pleura with the diaphragm firmly adherent to it is separated from the rib above and from the rib below the incision. A spreading retractor is then inserted and the interspace is forced open sufficiently freely to admit the hand. The retractor is then withdrawn and the cut edge of the muscle with the pleura is sutured to the diaphragm with chromic catgut; the diaphragm is brought out as far as possible through the interspace with suitable traction forceps (Figs. 8 and 9).

The skin, which has been freely undermined, is then sutured to the diaphragm with catgut, over the first layer of sutures, so as to shut off completely the intermuscular and fascial planes. The patient may then, if preferred, be sent back to bed and the diaphragm be opened in from 24 to 36 hours, when the muscles and skin have become completely adherent to the diaphragm, or, the diaphragm can be incised at once (Figs. 10 and 11).

In the majority of cases, after smearing the suture line with sterile vaseline, it is safe to open the diaphragm at once. After the diaphragm is opened sufficiently to admit the hand it should first be ascertained that the general peritoneal cavity is walled off completely from the abscess (it usually is); the

Fig. 9. Suturing the skin over the cut muscle edge to the diaphragm.

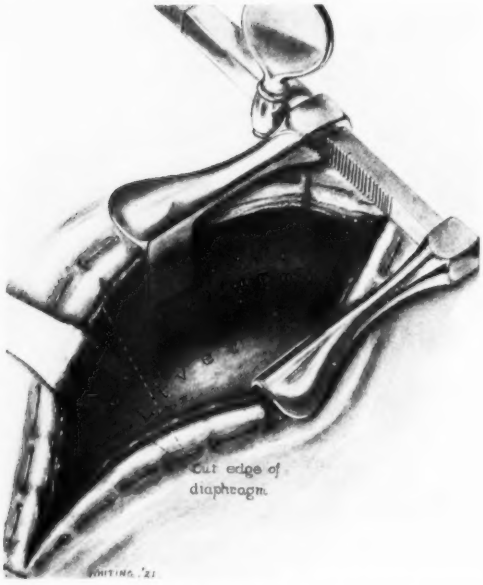

Fig. 10. Retraction of diaphragm showing space between it and the liver.

liver, the stomach, the transverse colon, and omentum, as a rule, completely wall off the abscess. Care should be taken not to destroy these adhesions. After carefully clearing out all the abscess area and swabbing the cavity dry, a separate piece of iodoform gauze is packed along the adhesions, separating off the general peritoneal cavity, and a small separate piece is packed over the posterior angle of the incision to promote granulation and protect that angle from breaking through into the thorax. A lighted retractor is used carefully to inspect the entire abscess in order to avoid overlooking a pocket or a second abscess. The parts are palpated to make sure that there is not an underlying liver abscess. Finally the cavity is swabbed with ether and a two-way catheter

TABLE IX.—OPERATIONS IN THIRTY-ONE CASES

Two operations (gastro-enterostomy followed in eight days by jejunostomy)	6
Three operations	2
Operations for other conditions, without relief, subdiaphragmatic abscess overlooked	6
Emergency cases, bad risks, patients died within from 3 to 14 days	7

Fig. 11. Opening in the diaphragm.

drain wrapped with iodoform gauze is placed so that it reaches the deepest part of the abscess cavity. The adjacent skin edges are draped with vaseline gauze. The patient is returned to bed and placed in a half sitting posture inclined to the right. The long end of the two-way drain protrudes through the dressing, and 1 ounce of saline is passed through the tube three times a day to clear it for drainage. On the second day the dressing is changed down to the vaseline gauze, which is not disturbed. On about the sixth or eighth day the patient is returned to the operating

TABLE X.—ONSET IN THIRTY-ONE CASES

	Average time from onset to death	Cases
Insidious with acute exacerbation...	18 days	10
1 9 months' history, with perihepatic abscess followed by rupture of colon.		
1 6 months' history.		
1 7 months' history.		
1 12 months' history.		
Acute	13 days	9
Insidious	33 days	12
1 history of 18 months, after ruptured pus tube.		
1 history of 13 months, after acute appendicitis or ruptured pus tube.		
1 history of 4 months following extensive burns on arm.		

TABLE XI.—APPROXIMATE POSITION IN EIGHTY-TWO CASES OF SUBPHRENIC ABSCESS [1]

	Cases
Right anterior intraperitoneal	10
Left anterior intraperitoneal	12
Right posterior intraperitoneal	16
Left posterior intraperitoneal	6
Right extraperitoneal	4
Left extraperitoneal	5
Location not clearly defined in reports	29
COMPLICATIONS	
Empyema (1 double)	11
Mass	15 [2]
Gas	5
Lung abscesses	3
Perforation of diaphragm	4
Liver abscesses	11
Operation with wrong diagnosis	4

[1] The exact positions were not stated in many cases.

[2] Mass or bulging noted in only 15 cases but undoubtedly was present in a much higher percentage. Same applies to gas.

room, gas is administered if necessary, and the drain and all the packing are removed. The cavity is thoroughly swabbed with saline, and inspected. A lighted retractor is used in inspecting the cavity. The wound is packed with glycerin and saline (5 per cent), and a shorter two-way catheter is left in position until the cavity is gradually closed. As early as possible the edges of the incision are drawn together with adhesive strips. Too frequent changing of the deep dressing should be avoided; it serves only to destroy the young granulation and to excite an increase of temperature. Forced feeding, alkalinization (120 grains sodium bicarbonate every 24 hours), glucose, and fresh air help to restore the patient. In many of these cases in which the abscesses have been well walled off and thoroughly dealt with at the first operation, it has been possible to resort to partial secondary suture on the eighth or tenth day. The advantages of this operation are:

1. Unnecessary mutilation of the wall which is involved in rib resection is avoided, thereby the possibility of osteomyelitis and periosteitis, so frequent a sequela of rib resection in the presence of pus, is also obviated.

2. A free exposure is made to allow easy access to the subphrenic spaces.

3. The minimum of fresh tissue is exposed to re-infection.

TABLE XII.—APPROXIMATE POSITION IN THIRTY-ONE CASES OF SUBPHRENIC ABSCESS

	Average time patient lived after operation	Cases
Right anterior intraperitoneal 3 acute 3 insidious 3 insidious with acute exacerbation	19 days	9
Left anterior intraperitoneal 1 acute 5 insidious 4 insidious with acute exacerbation 1 also right anterior intraperitoneal 1 also right posterior intraperitoneal 1 also pelvic abscess	25 days	10
Right posterior intraperitoneal 3 acute 2 insidious 1 insidious with acute exacerbation 1 also retrocæcal and pelvic abscess	15 days	6
Left posterior intraperitoneal 2 acute 1 insidious with acute exacerbation 1 also left extraperitoneal	13 days	3
Right extraperitoneal 1 insidious	38 days	1
Left extraperitoneal 1 insidious 1 insidious with acute exacerbation 1 also had right extra	21 days	2

4. Primary or secondary hæmorrhage from intercostal vessels does not occur because the vessels are not approached, and hæmorrhage from the diaphragm has been controlled by the double layer of sutures.

5. The prolonged painful dressing of a superficially granulating surface is avoided.

From a careful study of the literature and of the cases represented in the tables, certain general conclusions seem warranted (Tables V to XIII).

CONCLUSIONS

1. Subphrenic or subdiaphragmatic abscess is a grave condition and causes a high mortality. The convalescence of patients who recover is long, tedious, and accompanied by serious complications, such as renal and thoracic lesions which often leave the patient in chronic invalidism.

TABLE XIII.—COMPLICATIONS IN THIRTY-ONE CASES

	Cases
Perinephritic abscess	3
1 left extraperitoneal, with perforation of colon.	
1 right extraperitoneal, with perforation of duodenum.	
1 right and left extraperitoneal.	
Liver abscess	3
2 with multiple foci.	
1 with single focus.	
Lung abscess	2
Perforation of diaphragm	2
Empyema	7
3 bilateral.	
4 single.	
Pericarditis	2
General septicæmia (clinical diagnosis)	3
Peritonitis (varying amount of serofibrinous or fibrino-purulent exudate)	7

2. The serious sequelæ of the disease are due to the fact that the condition is not recognized sufficiently early, or is not dealt with promptly and completely.

3. The condition is secondary to infection elsewhere, and a high percentage of cases follows upper abdominal infection at operation or postoperatively.

4. Gravity accounts for the selection of the subphrenic area in the development of the abscesses following abdominal soiling.

5. Every effort should be made to prevent soiling of the subphrenic area during upper abdominal operations, and drainage, particularly of the upper abdomen, should be employed only when absolutely essential.

6. Subphrenic abscess should be suspected in all patients, who, following abdominal operations, maintain for no obvious reason, an elevation of temperature and pulse.

7. X-rays should be employed as an early diagnostic aid.

8. Needling for diagnosis is a dangerous practice, and should be used only to rule out pleural effusions. The needle should not be passed through the diaphragm into the abscess until the patient is on the operating table, then if pus is located, the needle should be left in position and the operation carried out without delay.

9. More deliberate and protracted operations can be performed with minimum risk to these emaciated and seriously ill patients under paravertebral anæsthesia, than under general anæsthesia.

10. A wide exposure of the abscess area is necessary.

11. Efficient drainage must be secured.

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THE TREATMENT OF TUMORS OF THE BLADDER WITHOUT LOCAL EXCISION

An Experimental and Clinical Study

By B. C. CORBUS, M.D., F.A.C.S., Chicago

DURING the last 10 years the treatment of tumors of the urogenital tract and particularly tumors of the bladder has received serious consideration by the urologist. This study has been stimulated by the fact that, despite our advances in surgical technique, the results following excision of tumors of the bladder have been far from brilliant. As recently as May, 1920, Lower said: "Undoubtedly the most difficult outstanding problem in genito-urinary surgery is the treatment of malignant tumors of the urinary bladder." Aside from the disposition of the benign papillomata by fulguration, the results have been most discouraging. This is true of carcinoma and papillary carcinoma and is especially true of those malignant tumors that involve the ureteral ostium.

During the last 3 years there have appeared in American literature papers by our foremost urologists, and all seem to agree that wide and clean excision offers the best method in the treatment of malignant growths. When such excision is impossible, the actual cautery has been applied in many instances with some degree of success.

Geraghty says: "It is of interest to note that the use of radium alone has not diminished the tendency of bladder tumors to recur, recurrences being observed in about 30 per cent of cases treated."

Rhodenburg and Prime have shown that tumors treated with a low degree of heat produced by diathermy or radiation alone, show but little inhibition or recession in growth when compared to tumors treated by a combination of both these agents. These authors conclude that low degrees of heat applied for varying periods of time have a lethal action on neoplastic cells *in vitro* and, with proper dosage, is effective in 100 per cent of the cases. Histological examination of tumors which have been treated by diathermy reveals cellular changes similar to those observed in tumors exposed to radiation.

James B. Murphy and E. Sturm showed that it is possible to inhibit the growth of cancer in rats, experimentally, by low heat generated by lamps.

So little has appeared in American literature concerning diathermy, that it seems pertinent to give a brief résumé of its history.

HISTORY OF DIATHERMY

Most urologists are familiar with the d'Arsonval current. Its method of production and application to tumors under the name of electrical coagulation or desiccation is well known, but few realize that diathermy is absolutely the same thing — many times stronger in its depth of penetration but with a more balanced control.

Professor Zimmer, of Paris, has defined diathermy as a form of thermotherapy which utilizes electrical energy for the production of thermal effects in the depths of the tissues.

In 1907, at Dresden, Franz Nagelschmidt, of Berlin, demonstrated with his own instrument the "heating through" of tissues by high frequency currents. He was the first in England to demonstrate the use of diathermy in the treatment of cancer, having done so in Mr. Harmer's clinic, at St. Bartholomew's. Consequently, Mr. Harmer may be said to be the pioneer of this method in England.

In 1910, Eugene Doyen presented to the International Congress of Physiotherapy an account of the treatment of cancer by means of electrically produced heat.

In 1919, Norman Patterson, writing on the treatment of malignant neoplasms of the larynx says: "No excision of a carcinomatous growth in the tongue, mouth, or pharynx, however small that growth may be, should be carried out with the knife if diathermy is

available." He makes no mention, however, of a combination treatment with radium.

Turner, with Iredell, advocates diathermy in the treatment of malignancies. Turner demonstrated the method before the Royal Society of Medicine, London, 1919.

Harrison is in accord with Patterson's views in regard to treatment by diathermy applied in diseases of the pharynx. According to Pfender, electrocoagulation is the most valuable adjunct to X-rays in the treatment of cancer of the skin, lip, tongue, tonsils, pharynx, larynx, cervix uteri, and rectum.

During the last few years, Gustav Kolischer has been an ardent advocate of the use of diathermy followed by radium, and at the meeting of the American Urological Association in Chicago, in 1918, he demonstrated the application of diathermy to a carcinoma of the bladder. The apparatus used at that time was one of special design. He has not only advised the early application of diathermy to neoplasms of the bladder but he has included in his treatment malignant tumors in other parts of the body.

Recently, Claude Saberton published a treatise on *Diathermy in Medical and Surgical Practice*, in which he gives a complete description of its origin, methods of application, and clinical results together with an excellent bibliography.

At the present time, there are available two large instruments manufactured by the Victor Electric Company and the Wappler Electric Company respectively. Among the English instrument makers, there are available several varieties of electrodes, but in this country we have been obliged to have our own special electrodes made to order. Of course, the electrodes vary according to the nature of the tumor, its site, and the method employed in its destruction.

In consideration of the work that has been done in the treatment of bladder tumors and as a result of the experiments described in the following, it seems possible to make malignant tumors of the bladder as easily accessible as cutaneous cancers, both for postoperative observation and for the application of radium.

Experimental work on dogs shows how easily the ureteral wall can be "burned back" by means of diathermy. The offering of this method as a possible substitute for any cutting procedure is presented in the following experiments and also in a later paragraph.

EXPERIMENTAL DATA

(With the assistance of Dr. Vincent J. O'Conor)

The degenerative and regenerative changes brought about by the action of diathermy on the bladder wall were studied in a series of five dogs. This study was undertaken for the purpose of determining the extent and character of the reaction and the type of subsequent scar-tissue formation, when the normal bladder wall of the dog had been subjected to electrocoagulation.

Direct "burning back" of the intramural portion of one ureteral wall was accomplished in three animals.

The dogs were anæsthetized with chloroform and placed upon a thoroughly insulated operating table. All operative procedures were carried out under strictly aseptic technique.

One ampere of diathermic current was used in the electrocoagulation. The bladder was opened in the median line and the trigone and ureteric orifices exposed. The slow coagulation process was then applied to the bladder wall, trigone, or the area about the ureteric orifices. The inactive electrode was placed beneath the lower lumbar region.

RESULTS OF EXPERIMENTS

Experiment 1. A medium-sized mongrel bitch was operated upon February 10, 1921. One ampere of diathermic current was applied to the bladder wall, over an area 1 inch square, for 30 seconds.

The immediate effect was a slow coagulation, or a "cooking through," of the tissue so that it became ischæmic, slightly contracted and slate colored. Desiccation took place without any apparently violent reaction in the tissues and the electrode was removed at the first sign of withdrawal of fluid from the tissue; that is, as soon as "bubbling up" occurred at the edges of the electrode. After removal of the electrode, the edges of the diatherminized tissue were seen to be slightly charred, in contrast to the markedly necrotizing effect produced by the unipolar current or actual cautery.

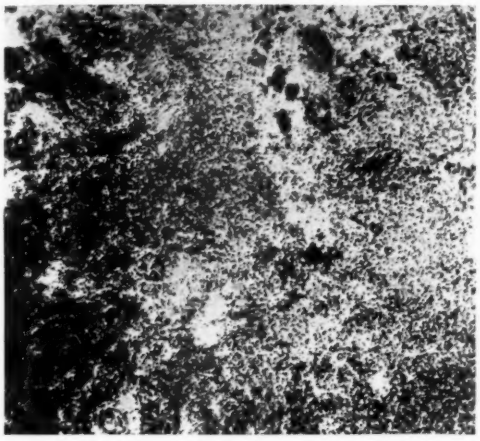


Fig. 1. Specimen of a diathermy burn of the bladder of a dog sacrificed on the second day. Microscopically the submucosa and muscularis show extensive polymorphonuclear and lymphocytic round-celled infiltration and a small amount of extravasated blood.

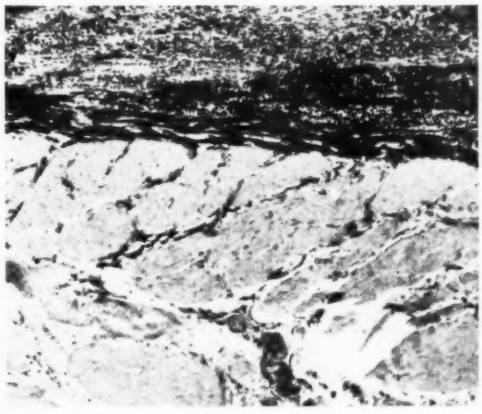


Fig. 2. Specimen of a diathermy burn of the bladder of a dog sacrificed on the eleventh day. Microscopically the superficial structures show a marked round-celled infiltration, no vascularity, or extravasated blood. The upper layers of muscle bundles showed a slow, long-standing degeneration with loss or disintegration of the nuclei. The more superficial muscle bundles are poorly stained and show degeneration.

Forty-eight hours later, the dog was sacrificed. The bladder wall about the coagulated area was slightly œdematous and hyperæmic, while the area itself was puckered and bloodless. The edges were black and necrotic and a slough was beginning to form. The area was somewhat indurated throughout the entire thickness of the bladder wall, but there were no adhesions outside of the bladder. Microscopically (Fig. 1) this area shows complete destruction of the mucosa, submucosa, and more superficial muscle layers. The submucosa and muscularis show extensive polymorphonuclear and lymphocytic round-celled infiltration and a small amount of extravasated blood. The line of demarcation between the diatherminized tissue and the surrounding normal tissue was very sharply defined. The area of coagulation, however, spreads in a cone-shaped manner as the deeper structures are reached.

Experiment 2. On the same day, a similar experiment was conducted and the dog was sacrificed on the eleventh day after diathermy had been applied to the bladder wall. The superficial sloughing mass over the burned area had almost completely separated leaving a clean, "healthy" granulating surface. The reaction and œdema in the surrounding structures had disappeared. There were a few filmy adhesions between the posterior bladder wall and the rectum. Otherwise the bladder was mobile and normally contractile.

Microscopically (Fig. 2) the superficial structures show a marked round-celled infiltration, no vascularity or extravasated blood, and the upper layers of muscle bundles show a slow, long-standing degeneration with loss, or disintegration of the nuclei. The more superficial muscle bundles are poorly stained and show degeneration.

Experiment 3. On November 14, 1920, a full-grown collie bitch was operated upon under chloroform anæsthesia. A suprapubic cystotomy, followed by the application of diathermy to the right intramural segment of the ureter, was done. The ureter was "burned back" over its entire visible extent. The dog made a complete recovery, with healing of the abdominal wound by first intention, on the fourteenth day. On April 24, 1921 (21 weeks later), the dog was sacrificed and the entire urinary tract was removed *en masse.*

Autopsy record. The mid-line incision was well and firmly healed by first intention. The bladder appeared slightly contracted. There were no peritoneal adhesions over the anterior or lateral surfaces of the bladder. Posteriorly there were a few filmy adhesions to the rectum but no fixation of the bladder. Both kidneys and ureters were normal in every respect.

The right half of the trigone (Fig. 3) was replaced by grayish firm scar tissue. The right ureteric orifice was 1.5 centimeters posterior to the normal position and the ostium, which was opened into the scar-bearing area, was not contracted or obstructed. The scar occupied the entire thickness of the bladder floor over this area.

Experiment 4. A full-grown Boston terrier bitch, was operated upon January 12, 1921. The operation was similar in every way to that done in the foregoing experiment. Autopsy was performed April 14, 1921, 12 weeks after operation. The kidneys and ureters were normal in every respect.

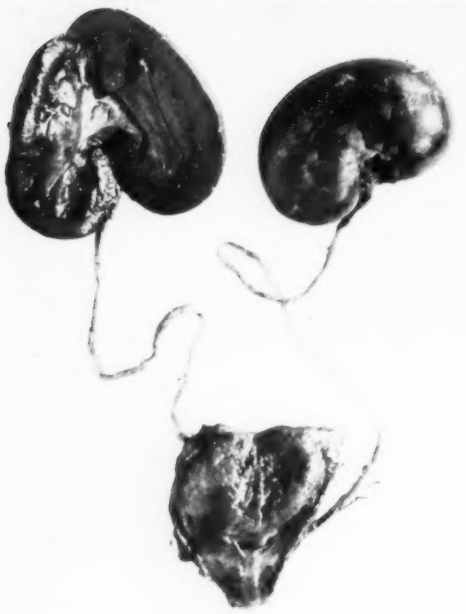


Fig. 3. Specimen of a right ureteric opening of a bladder of a dog 21 days after diathermy burn. The right half of the trigone is replaced by grayish, firm scar tissue. The right ureteric orifice is 1.5 centimeters posterior to the normal position and the ostium, which opened in the scar-bearing area, is not contracted or obstructed over this area. The scar occupies the entire thickness of the bladder floor.

There were several fine adhesions between the fundus of the bladder and the peritoneum and omentum. There were no contractions of the bladder and there were no adhesions posteriorly.

The right half (Fig. 4) of the trigone was composed of an indurated, firm, grayish white scar tissue. The ureteral opening on the right side had been burned back for a distance of 2 centimeters and was still functioning normally, although it was surrounded by scar tissue and the ostium was contracted to a pin-point size. The scar tissue occupied the entire thickness of the bladder wall.

Microscopic sections (Figs. 5 and 6) of these areas showed: a sharp line of demarcation between the surrounding tissue and the diatherminized area. The latter was entirely replaced by bands of fibrous tissue, arranged both longitudinally and transversely. The formation was very thick and the bundles were closely interwoven with no intervening areolar tissue. The epithelial layers of the bladder mucosa had been replaced by stratified squamous epithelium. There were no muscle bundles present in this area except at the extreme edge of the serous

Fig. 4. Specimen of a diathermy burn of the right ureteral opening of a bladder of a dog 12 weeks after operation. The right half of the trigone is composed of an indurated, firm, grayish white scar. The ureteric opening on the right side which had been burned back for a distance of 2 centimeters was still functioning normally, although it was surrounded by scar tissue. The ostium is contracted to a pin-point size. The scar tissue occupied the entire thickness of the bladder wall.

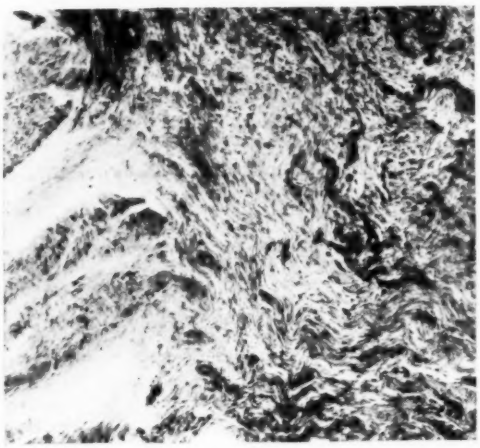
surface. The process of regeneration is one of dense fibrous tissue production with ample vascularity.

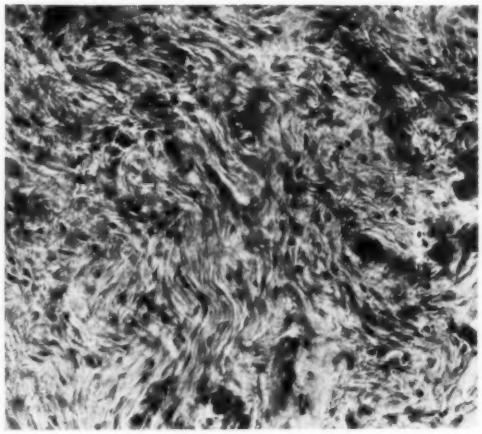
Experiment 5. A similar experiment was performed on January 12, 1921, on a black and white fox terrier bitch. After 12 weeks of normal activity, the dog was sacrificed on April 4, 1921. The abdominal incision had healed by primary intention. There were no adhesions about the bladder either to the rectum or the anterior parietal wall. Both ureters were normal; there was no dilatation of the renal pelvis, no atrophy of the renal parenchyma, and no signs of infection in either kidney. The bladder was slightly contracted but mobile. Otherwise, the structure was normal except that the right upper quadrant of the trigone was replaced by a smooth, grayish, fibrous tissue (Fig. 7) in the center of which the ureteral opening protruded. The orifice is 1.5 centimeters posterior to its mate. Both are normally patent.

SUMMARY

Electrocoagulation of the normal bladder wall of the dog by diathermy is followed by distinct, uniform, tissue reaction.

The immediate effect is a slow "cooking through" of the underlying tissues, the effect upon the deeper structures being the same as that upon the mucosa. This is followed by an





Figs. 5 and 6. Microscopic sections of scar tissue taken from dog's bladder 12 weeks after diathermy burn. The areas show a sharp line of demarcation between the surrounding tissue and the diatherminized area. The latter is entirely replaced by bands of fibrous tissue arranged both longitudinally and transversely.

aseptic death of the submucosa and muscularis. Round-celled infiltration is marked only for the first three days.

Eventually, the entire area is replaced by a dense proliferation of fibrous tissue, the line of demarcation between the treated area and the surrounding normal tissue being definitely preserved.

The ureteral wall may be "burned back" in the dog almost to the entrance of the intramural portion. The results in three dogs under observation for from 3 to 5 months have shown no derangement of function in the ureteral activity or the contractility of the bladder. No obstruction to the ureteral outflow occurred in 5 months.

DIAGNOSIS

In order to effect a cure in vesical cancers, an early diagnosis is imperative. We all know that the first cardinal symptom of neoplasm of the bladder is hæmorrhage. If the laity and the medical profession at large could only realize that hæmaturia is an even more dangerous symptom than hæmoptysis, more tumors would be recognized early, treatment instituted, and the prognosis rendered more favorable thereby. Unfortunately, this important symptom is not evaluated in its true significance.

Diagnostic excision. The practice of excising a piece of tumor for diagnosis has been in vogue for many years. It made no difference whether the tumor originated in the bladder, uterus, or breast, the main idea was to make a diagnosis, with little thought that the prognosis might be jeopardized by this untimely excision of tissue.

We are all familiar with the controversy that has arisen at times with pathologists over the malignancy or non-malignancy of a given tumor, because the portion removed may show none or very few malignant changes while the remainder of the tumor may be definitely cancerous.

The prevention of metastasis should ever be in mind in the treatment of tumors of the bladder. It is best not to attempt to excise a piece of tumor when the mere excision may be the cause of a transplantation metastasis. If it becomes necessary to excise tissue for diagnosis, the cautery method should be used.

Personally, I believe that in tumors of the bladder, it makes very little difference, so far as the clinical course is concerned, whether a piece is taken for diagnosis or not. In the large majority of cases, cystoscopy, palpation, and X-ray examination, if intelligently performed, give all the positive information that is necessary.

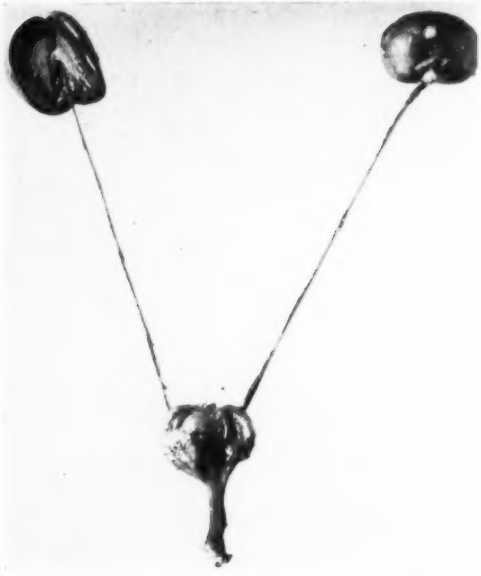


Fig. 7. Specimen of a diathermy burn of the right ureteric opening of a dog's bladder 12 weeks after burn. The right upper quadrant of the trigone is replaced by smooth, grayish, fibrous tissue in the center of which the ureteric opening protrudes. The orifice is 1.5 centimeters posterior to its mate. Both are normally patent.

Cystoscopy. We have been taught that all the papillomata are potentially malignant and that this malignancy increases as age advances. While this is true in a measure, we must not lose sight of the fact that malignancy appears in the young as well as in those of more advanced years.

It is impossible, in those cases that present themselves early for cystoscopic examination, to determine whether the papilloma is benign or malignant. Unfortunately, many cases come for examination when the malignant changes are advanced and infiltration of the bladder wall has occurred. It is at this period that cystoscopy will often disclose all we need to know, while a biopsy performed at this time is only of scientific interest and may be a dangerous procedure.

The salient features of a malignant neoplasm of the bladder, as viewed through a cystoscope, are:

1. The changing of a papillomatous tumor into a sessile growth;
2. Early necrosis or erosion of the tumor mass that has not been fulgurated;
3. Presence of accessory tumors slightly adjacent to a central tumor, which may or may not be associated with bullous œdema;
4. In the absence of a positive source of infection, the presence of a severe cystitis. This condition, associated with a bladder tumor is often indicative of malignancy.

Palpation. The palpation of tumors situated in the bladder through the abdominal wall is difficult. Occasionally, however, when the tumor involves the vertex, this can be accomplished with success. As at least one-half of the tumors occur on the base or lateral sides of the bladder wall, much valuable information can be obtained by rectal examination in the male. Here, the infiltration can often be distinctly palpated. In the female, the vaginal examination as a rule reveals the extent of the infiltration more distinctly than the rectal examination does in the male.

Roentgenography. No examination, however thorough, should be concluded without an X-ray examination of adjacent bony parts, for metastasis. If extension has occurred, the prognosis is grave and only palliative relief can be expected.

TREATMENT

Experience has led me to believe that the treatment of bladder tumors may be classified as follows:

1. *Benign papillomata.* If there are but few papillomata and they are easily accessible, transurethral fulguration is used followed by the transurethral application of radium with a special radium applicator. It has been our custom to fulgurate papillomata, then await developments. This I believe is a mistake. As all papillomata may be potentially malignant, it seems to me that the prophylactic application of radium is an additional means to destroy a smoldering malignancy.

2. *Multiple benign papillomata and tumors inaccessible transurethrally.* We use suprapubic fulguration with diathermy followed by radium applied through the suprapubic fistula by means of the special radium applicator.

3. *Carcinoma.* These tumors are treated by the same method as multiple papillomata,

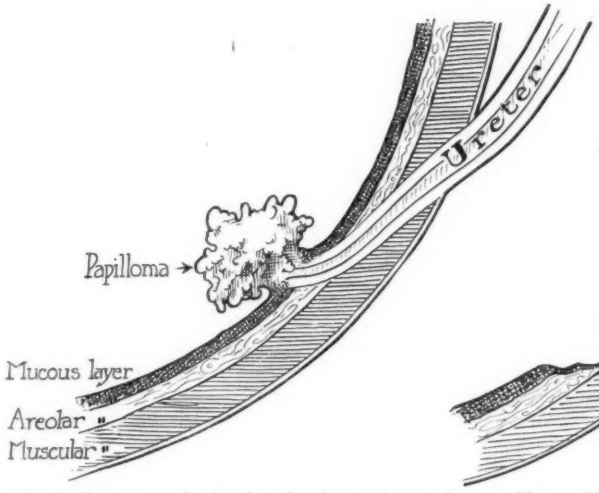


Fig. 8. Diagrammatic drawing showing ureter passing through the bladder wall; with its ostium obstructed by a papilloma.

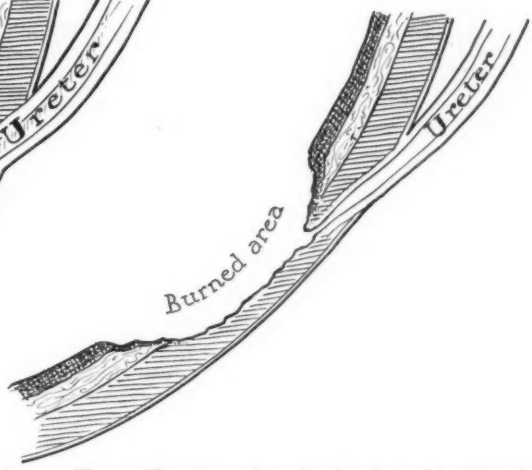


Fig. 9. The same view showing how the ureter is "burned back" by means of diathermy, including removal of the papilloma.

only the diathermy coagulation is more extensive and the radium is applied more intensively.

4. Tumors involving the ureteral ostium. Considerable literature has appeared relative to the treatment of the ureter when its ostium is involved in a vesical carcinoma. About 2 years ago, I had the opportunity of treating a vesical carcinoma that involved the left ureteral opening, where the neoplasm had been present for several years and where there was considerable involvement of the bladder floor as well as the ureter. Following destruction by diathermy, I was surprised, some months later, while looking into the bladder by means of the cystoscope, to find the ureter "burned back" fully an inch and to note that it was perfectly patulous and functionating.

Lower has shown how the ureter passes through the bladder wall for a considerable distance and he has devised a unique method of excising the intramural portion of the ureter when it is involved in papillary carcinoma.

As it is my desire to present a method of treating all vesical tumors without the use of any cutting procedure, the "burning back" of the ureter by diathermy is offered in place of this method of excision. This, I believe, is substantiated in view of the excellent results obtained in our experimental work on dogs and in a limited number of clinical cases observed during the past 3 years (Figs. 8 and 9).

TECHNIQUE

The employment of diathermy in the treatment of tumors of the bladder requires a careful preparation of the operating table and the proper adjustment of the wires from the electrodes in order to avoid short circuiting.

Preparation of operating table. We have found it advisable to cover the table with several layers of thick paper, over which is placed ⅛-inch rubber sheeting. This must be carried well up to the head piece to insure perfect insulation of the head. Over this is placed some heavy woolen material to keep the body as dry as possible, which may be assured by using great care not to use any excessive amounts of liquids in the pre-operative cleansing of the operative field. It is well to have the operator and his assistant stand on wooden platforms that are covered with paper and rubber strips ⅛ inch thick.

The indifferent electrode consists of a piece of blocked tin about 5 by 6 inches and is placed under the patient just above the but-

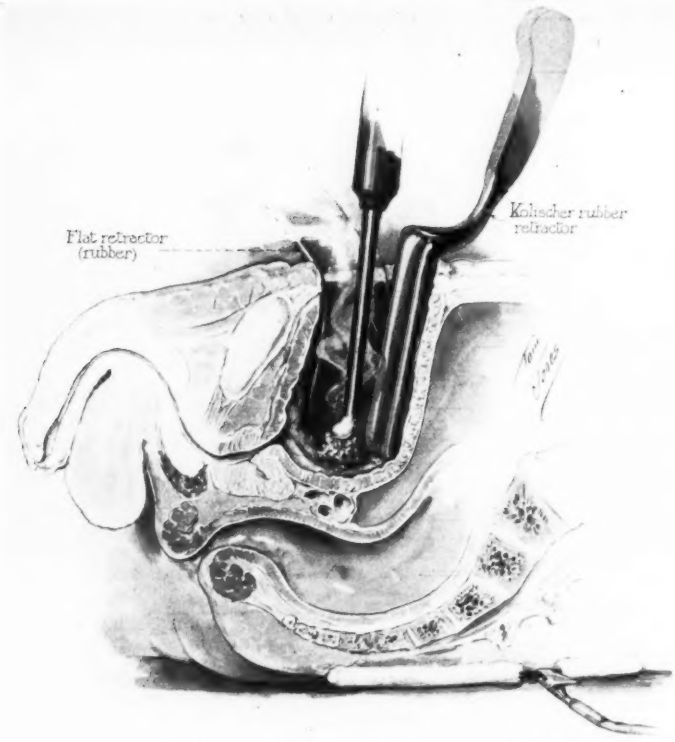


Fig. 10. Illustrating the inactive and the active electrodes, the Kolischer retractor and the flat retractor all in place; with the active electrode immediately over the tumor.

tocks. Between the electrode and the patient's skin, is placed gauze that is well moistened with hypertonic salt solution, which minimizes the danger of a superficial burn. When the operation is prolonged, this gauze should be moistened in order to protect the skin under the electrode. After the operation, the site of the indifferent electrode should always be examined to see that no burning of the skin has taken place.

If a head-light is used by the operator, it is well to supply the current from a storage battery.

Great care should be used in giving the anæsthetic. Morphine and scopolamine with gas oxygen must be used, as ether anæsthesia is extremely dangerous due to possible short circuiting of the current.

The active electrode consists of a rubber handle through which a metal core passes. The cable of the diathermy machine screws into its proximal end, while electrodes of various types may be screwed into the distal end. The choice of instrument depends upon the particular situation and character of the part we are called upon to treat.

Suprapubic operation. Following a preliminary cystoscopy and a careful mapping out of the tumor, the patient, with the bladder moderately distended, is anæsthetized and placed in the Trendelenburg position. The suprapubic opening is made sufficiently large to insure a good view of the bladder cavity and the malignant growth.

Exposure is facilitated by the use of proper retractors. As metal is a conductor of elec-

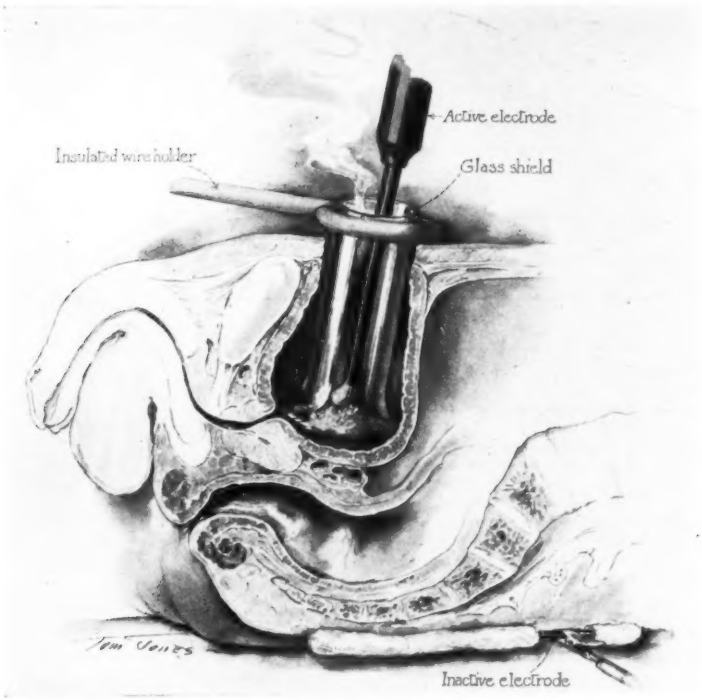


Fig. 11. Showing the glass speculum with the insulated wire holder. The active electrode is within the speculum.

tricity, it is well to substitute rubber in its place. The large flat rubber retractor designed by Kolischer is very useful where one retractor alone is used. We have designed two flat rubber retractors that help to pull the bladder laterally and greatly facilitate the exposure of the tumor mass (Fig. 10). The use of a Barnes' bag in the rectum is a great help in exposing the field to be burned. It also acts as a shield to protect the rectal wall. In order to protect the bladder wall and the adjacent structures from extraneous burning, a glass speculum is placed over the tumor mass.

When everything is in readiness, the surgeon grasps the active electrode and passes it down the glass speculum which has been previously placed over the tumor or portion of the tumor to be burned (Fig. 11). The electrode is placed firmly in contact with tissue to be burned and the current is applied. After a time, bubbles of gas and steam are given off and cracking sparks jump from the sides of the electrode to the adjacent tissue. This is a sign that the tumor mass has been "cooked." The current should be immediately turned off to avoid making too deep a burn. If the malignant growth is extensive, it may be well to adjust the glass speculum in order to burn the mass in its entirety.

Because of the electrocoagulation, the burned tissue is hot, dry, and white in appearance, the depth of the coagulation depending upon the size of the electrodes, the amount of current used and the depth of tissue between electrodes (Fig. 12).

Having once found the established strength of current used in any particular case, the current regulator may be left in position for the next application of the electrodes. We have made a practice of permitting the suprapubic wound to heal after we have disposed

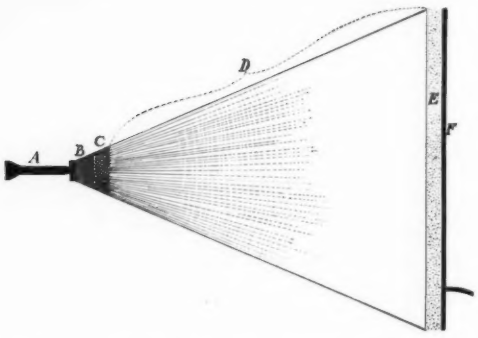


Fig. 12. Diagrammatic representation of what occurs under active electrode in surgical diathermy. *a*, One-fourth inch active disc electrode; *b*, tissues visibly coagulated to a depth approximately equal to the diameter of the disc electrode used; *c*, area of tissues in which the current density has been insufficient to cause coagulation, but has probably been sufficient to destroy the vitality of the cells; *d*, gradual diminution of current density and heating effect; *e*, thick pad of gauze saturated in warm saline solution (1 ounce salt to 1 pint water); *f*, large indifferent metallic electrode. (Reproduced from *Diathermy in Medical and Surgical Practice*, by Claude Saberton.)

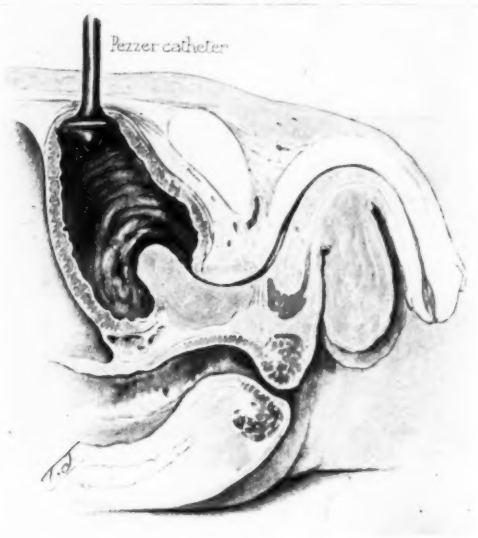


Fig. 13. Illustrating the position of the de Pezzer catheter, after cystotomy.

of the neoplasms. This, I believe, can be improved upon, for the following reasons:

Bladder tumors are less accessible once the suprapubic wound heals. With a suprapubic fistula, the possibility of making these tumors as easily accessible as cutaneous cancers is actually created by the combined cystoscopic radium applicator. The putting at rest of the bladder, during convalescence, by establishing a permanent drainage, adds greatly to the comfort of the patient and permits the inspection from time to time of the vesical cavity with a minimum of discomfort to the patient.

As the treatment of malignant tumors of the bladder is at best precarious and uncertain, it seems desirous to put the bladder in such a position that the tumor can be under constant observation for a long period of time. With this idea in mind, the bladder is closed after the method of Pilcher in making his preliminary cystotomy for prostatectomy. This permanent suprapubic fistula insures rest of the bladder, offers an opportunity for study of the tumor mass, from time to time, by suprapubic cystoscopy (thus bringing the growth under direct observation, as it were) and affords the direct visual application of radium to the tumor mass, the two latter procedures causing the patient only a minimum of discomfort (Fig. 13).

The suprapubic fistula is maintained for many months, but the de Pezzer catheter is changed only at the time of the insertion of the radium cystoscopic applicator. However, the patient is instructed to keep the fistulous tract clean by daily cleansing with hydrogen peroxide and an antiseptic.

Sodium acid phosphate and hexamethylenamine are given internally and the patient is encouraged to drink large quantities of water during the day.

The catheter may be corked with a stopper and the urine withdrawn from time to time, or the patient may be allowed to void at will; but, at night, it is well to connect the catheter with the drainage tube at the side of the bed (Fig. 14).

ADVANTAGES OF DIATHERMY OVER CUTTING PROCEDURES

In the operative treatment of neoplasms of the urinary bladder, it is necessary in working out a technique to keep constantly in

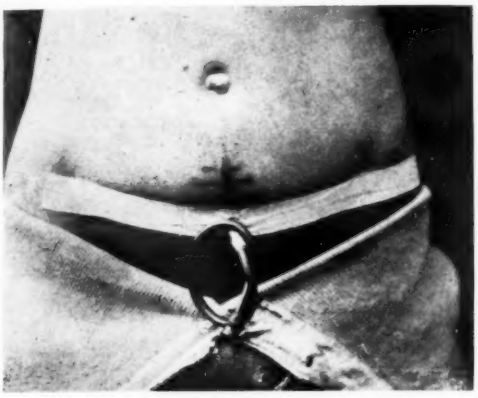


Fig. 14. Photograph of patient with de Pezzer catheter in place, the distal opening of the catheter being plugged with a cork.

mind that every step of the operation must be so planned as to avoid implanting tumor cells on raw or cut surfaces. This has been recently emphasized by Beer.

Diathermy is absolutely bloodless if a flat or blunt electrode is employed; which, if properly used, insures not only total destruction of the mass but also sufficient coagulation of the tissues in the immediate neighborhood to minimize the possibility of cell implantation.

Vascular structures situated in the near vicinity are sealed, thereby lessening the absorption of infection. Consequently, a shorter convalescence is insured.

On account of the absence of any extensive cutting procedure postoperative shock is minimized, which is of great value in operating upon patients of advanced years.

Lastly and most important of all, are the density and extent of the scar tissue that results after the employment of diathermy in treating malignant disease. The body defense against carcinoma metastasis lies in the formation of a connective-tissue capsule. The scar tissue that is formed after a diathermy burn is more dense and spreads farther into the surrounding tissue than is the case after any cutting operation. We have here then an extensive reinforcement of nature's attempt to throttle the embryonal cell.

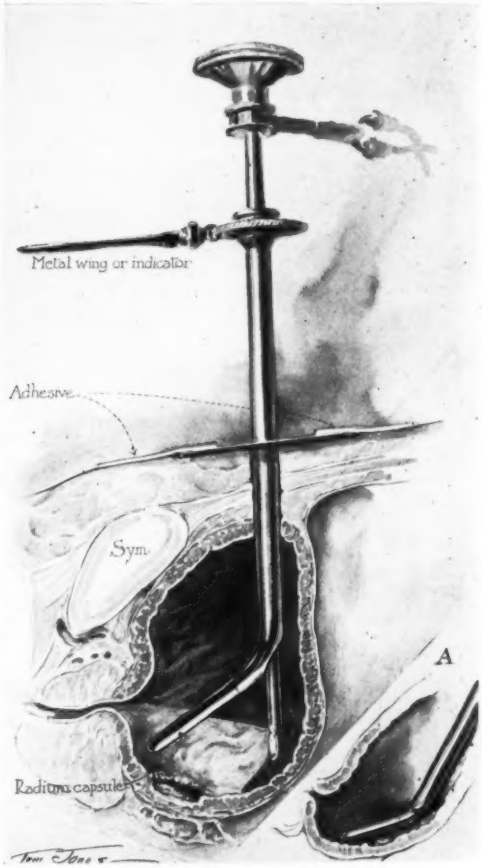


Fig. 15. Author's cystoscopic radium applicator. *a*, Shows the radium capsule lying on the tumor after withdrawal of the observation cystoscope.

THE USE OF RADIUM

The cystoscopic radium applicator (Fig. 15), that is here illustrated, is the same as that devised for the urethra and illustrated in this journal last year, except that it is a little shorter and contains a flat shoulder at the proximal end that enables it to be fastened to the abdominal wall with adhesive tape. The nickeled radium capsule that was originally used has been replaced by one made of gold.

The amount of radiation that is required to effect a cure, if such can be expected in a given case, varies. If one expects the best

results in the treatment of these tumors the co-operation of a radiologist is advised.

It has been suggested that the radium applicator might be of service in placing the radium element over a carcinoma of the prostate, once a suprapubic fistula has been established.

I desire to acknowledge my appreciation and thanks to my associate, Dr. V. J. O'Conor, for his suggestions and assistance in the experimental work reported in this paper.

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THE PHYSIOLOGICAL METHOD OF TENDON TRANSPLANTATION

BY LEO MAYER, A.M., M.D., NEW YORK

DURING the winter of 1916 I published a series of articles in this journal describing a new method of transferring tendons. This method I termed "physiological" since it attempted to correlate each step of the operation with the known facts of tendon physiology and anatomy. The first paper gave a brief review of the research work dealing with the finer structure and the function of tendons, the second paper dealt with operative technique and the third, with the clinical results. I was able at that time to report about 200 cases operated on during my service at the Oskar-Helene Home for Crippled Children. Since the progress of these cases was sufficiently encouraging to warrant further trial of the method, I have used it consistently during the last 3 years, and with the further refinement of the technique which this additional experience has brought, the results have improved correspondingly. To the helpful criticisms of colleagues, particularly to Dr. Steindler, of Iowa City, and to Dr. Bunnell, of San Francisco, this improvement is largely due. Dr. Steindler has advised the conservation of the blood supply of the tendons wherever this is feasible, and Dr. Bunnell by devising an ingenious clamp, has applied this method to the traumatic surgery of tendons. To invite further constructive criticisms as well as to report the present status of the physiological method, it seems advisable to describe the operative technique now employed and to summarize the end-results of the last 3 years' clinical experience.

The essential function of the tendon is transmission of the contractile force of the muscle. It corresponds closely to the rope of a derrick and just exactly as the entire action of the rope would be destroyed by a single clamp which prevented it from gliding, so, too, the function of the tendon is entirely inhibited by a single adhesion. The gliding mechanism of the tendon is therefore of the utmost physiological importance and its conservation is the first requisite in all tendon operations. Strange to say, despite this self-evident fact, no experimental work so far as I know, had ever been done on this subject until Dr. Henze and I, during the winter of 1912 at the suggestion of Professor Lange, of Munich, made a study of postoperative adhesions to tendons and the methods of preventing their development. This research proved that the introduction of foreign bodies of any kind, such as vaseline, bismuth paste, etc., instead of preventing the formation of adhesions served rather to encourage them; that on the other hand by retaining the normal relationship between the tendon and its sheath (as proposed by Biesalski), the normal gliding function of the tendon could be perfectly preserved. Before this

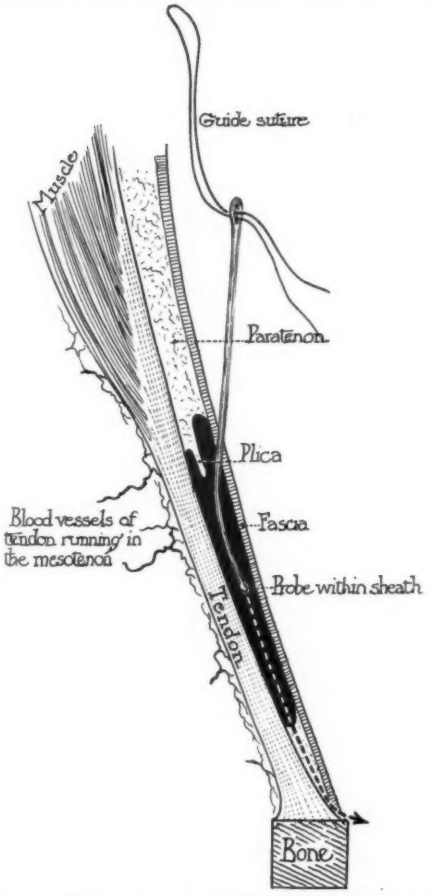

Fig. 1. Diagrammatic longitudinal section through the tibialis anticus tendon illustrating the manner of passing the probe downward through the tendon sheath. The dotted line and the arrow indicate the passage of the probe through the lower pole of the tendon sheath and out near the insertion of the tendon.

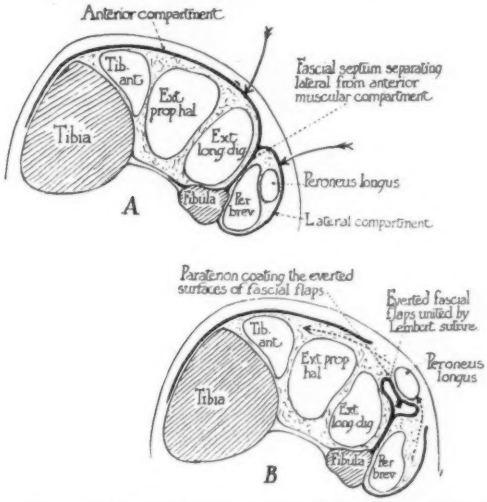

Fig. 2. Diagrammatic cross section of the calf illustrating the division into the anterior and lateral muscular compartments by a fascial septum (*a*). To transfer the peroneus longus tendon from the lateral compartment to the anterior, the fascia is incised at the points indicated by the arrows and the fascial edges are then everted and brought together by a suture as indicated in *b*. The paratenon or gliding tissue which coats the deep surface of the fascia prevents the formation of adhesions.

fact could be effectively applied to tendon transplantation on human beings, it was necessary to learn something about the gliding mechanism of tendons, a subject which, like everything else connected with the physiology of tendons, had been a closed book both to surgeon, physiologist, and anatomist. This second research, full details of which were published in the opening chapters of the volume "The Physiological Method of Tendon Transplantation" (Biesalski and Mayer), showed that the essential tissue concerned with the motion of the tendon was a very loose fatty mesh-work, rich in elastic fibers, which surrounds the tendon on all sides and because of its elasticity permits the tendon to glide to and fro beneath the rigid unyielding fascia. For this tissue I suggested the term *paratenon*. The tendon sheath is a closed sack containing fluid interposed between the tendon and the restraining fascial band or the bone at any place where the tendon changes its direction. The object of the sheath is to serve as a fluid buffer to diminish friction at this point. A sheath is not present when the tendon runs a straight course, since then the paratenon is sufficient to permit gliding. At the upper part of most tendon sheaths, there is a special mechanism termed the plica, which acts as a kind of valve permitting the free motion of the tendon and at the same time keeping the tendon sheath intact. The surface of the tendon is coated with cells differing in their histological structure from those in the deeper layer of the tendon and

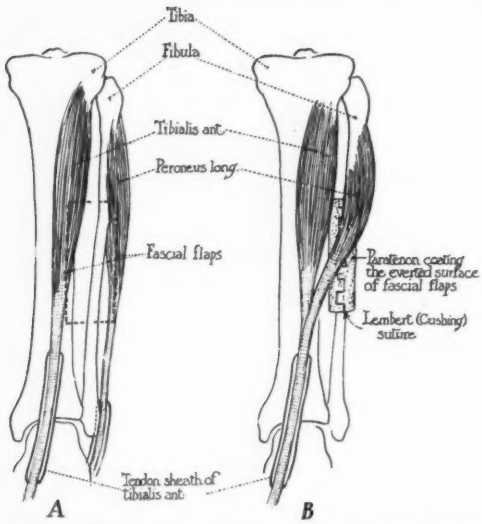

Fig. 3. Diagrams illustrating the transfer of the peroneus longus to replace the tibialis anticus. *a*, Shows the form and location of the fascial flaps which are everted to facilitate the passage of the peroneus longus from the lateral muscular compartment to the anterior. *b*, Illustrates the course of the peroneal tendon over the fascial flaps after they have been everted and united by a Lembert suture. The paratenon coating the everted deep layer of the fascia prevents the formation of adhesions.

judging by the formation of adhesions when these cells are destroyed, they seem to be particularly adapted to the gliding of the tendon. Where the tendon rubs against the bone or fascial band, these cells assume the character of cartilage cells. They are particularly poor in blood vessels, whereas the deeper layers of the tendon which are not exposed to friction are comparatively much more vascular.

The tension of tendons, as has been determined by a series of experiments on dogs as well as by careful measurements during operations on human beings, varies directly according to the strength of the muscle and the degres of its contraction, but for all muscles and all tendons one measurement remains constant: when under anæsthesia with the muscles completely relaxed, the extremity is held in such position that the origin of the muscle and the insertion of the tendon are brought as near together as possible, then the tension of the tendon is zero. For instance, if the foot is held inverted and dorsiflexed, in other words, the origin and insertion of the tibialis anticus muscle is brought as near together as possible, then the tension of the tibialis anticus tendon is zero. This fact is of easy application to all tendon operations since the operator need only hold the limb in the position indicated and suture the tendon with just enough force to render its course a straight one. In addition to the gliding mechanism and the tension of tendons, other important anatomical data were published dealing with the blood supply of tendons, the relation of tendons to fascial septa, the effect of traumatism and the relative strength of various methods of tendon suture.

Applied to tendon operations, these facts resulted in a system of operations in which the cardinal principle was the correlation of the operative technique with the known facts of tendon physiology, and in particular the retention of the normal relationship between the tendon and its gliding mechanism. There must, of course, be absolute asepsis, minimal hæmorrhage and minimal traumatism. In addition the operations must meet the following demands:

1. They must whenever possible restore the normal relationship between the tendons and the sheath.

2. The course of the tendon from its original site to that of the paralyzed tendon must run through tissue adapted to the gliding of the tendon. Injury to the periosteum or the crude boring of a hole through fascia or interosseous membrane is inconsistent with this demand.

3. The normal insertion of the tendon must be imitated wherever possible by implanting the tendon directly into bone or cartilage, preferably at the insertion of the paralyzed tendon.

4. The normal tension of the transplanted tendon must be re-established and the physiological length of the transplanted muscle thus maintained.

5. The line of traction of the transplanted tendon must be such as to enable it effectively to do the work of the paralyzed tendon.

The operations to be described in this paper fall into four groups:

Fig. 4. The author's tendon clamp.

First, tendon transplantations, or more accurately "transfers," in which the insertion of the tendon is altered.

Second, true transplants or "free" transplants, in which a portion of a tendon is removed and grafted into a new position, usually to bridge the gap between the retracted ends of a divided tendon.

Third, tendolysis to free a tendon from adhesions and prevent their reformation.

Fourth, tendon suture for traumatic division of tendons.

As the last is accurately described by Bunnell, I shall not repeat it here, but simply refer the reader to Bunnell's article in SURGERY, GYNECOLOGY AND OBSTETRICS for January, 1918. Tendolyses are now frequently done for the finger tendons, and I shall describe one such operation as typical. The free tendon graft is applicable to any site and I shall describe a typical operation for the lower and the upper extremity. My own experience has been concerned chiefly with the first group of operations, the tendon transfers, which are of the utmost importance in the treatment of the residual paralyses not only of poliomyelitis but of extensive gunshot injuries. In this group I shall describe four operations for the lower extremity, namely: for paralytic flat foot, club-foot, hollow foot, and paralysis of the extensors of the knee; and three for the upper extremity, for drop-wrist and for complete division of the flexors and extensors of a single finger.

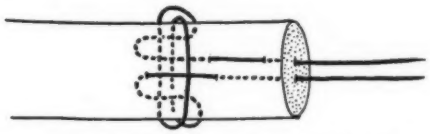

Fig. 5. The fixation suture. This is inserted by using a suture with a straight needle at each end. With the first needle, two transverse stitches are taken through the tendon and then a longitudinal which is brought out at the cut surface of the tendon. With the second needle a longitudinal stitch only is taken which emerges on the cut surface. This fixation suture will stand great tension without tearing.

TECHNIQUE IN DETAIL

GROUP I.—TENDON TRANSFERS

1. Paralytic flat foot. The operation usually indicated is the transfer of the peroneus longus to replace the paralyzed tibialis anticus. The chief anatomical difficulty in the execution of the operation is the fact that the peroneus longus lies in a fascial compartment separated throughout its extent from that of the tibialis anticus. To overcome this difficulty a fascial plastic is necessary. The first step of the operation is the preparation of the implantation site for the peroneal tendon. An incision about 2 inches long bowed with the convexity toward the sole of the foot is made over the insertion of the tibialis anticus. The paralyzed tendon is exposed at its insertion, slit longitudinally for about 1 inch and the subjacent bone or cartilage of the internal cuneiform is grooved with a small gouge for the reception of the peroneal tendon. It is advisable to prepare the implantation site as the first step of the operation so as to avoid exposing the peroneal tendon to the air more than is absolutely necessary. The method heretofore commonly practiced of freeing the peroneal tendon and wrapping it up in gauze while the implantation site is being prepared, is to be condemned as unphysiological, since the gliding cells on the surface of the tendon are readily traumatized by contact with any foreign substance. It is quite essential for the successful gliding of the transplanted tendon that it be transferred from its original site to the new one within a very few minutes and with minimal handling. The

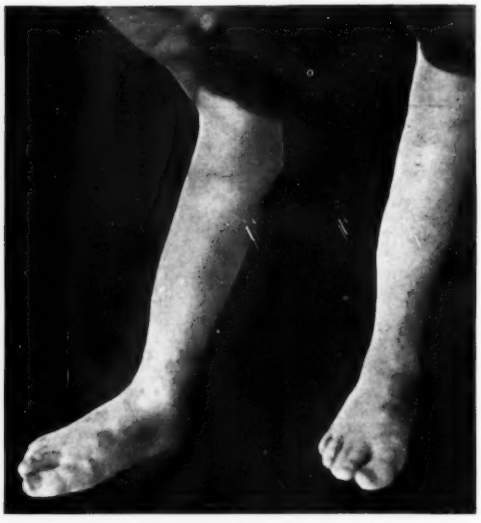

Fig. 6 (at left). Paralytic flat foot due to paralysis of the tibialis anticus and posticus.

Fig. 7. Same patient after transfer of the peroneus longus to replace the paralyzed tibialis anticus. The plano-valgus deformity has been entirely corrected.

cuneiform bone is purposely traumatized so as to encourage its osteogenetic activity. Adhesion between the tendon and the traumatized bone occurs in less than 16 days and the union by that time is sufficiently firm to permit active motion of the transplanted tendon.

The second incision about one inch long, is made near the upper pole of the tibialis sheath, about 2 inches above the tip of the internal malleolus. The sheath is opened just enough to permit the passage of a probe downward through the sheath and out at its lower extremity (Fig. 1). The tip of the probe is then seen to emerge just at the insertion of the tibialis anticus. The probe should be bent slightly near the tip and should be passed in such a way as to lie on the anterior surface of the tendon. Unless this precaution is taken, the probe has a tendency to slip off to the side and to traumatize the mesotenon or vascular membrane which connects the tendon with the floor of this sheath. Into the eye of the probe is threaded a strong silk or linen suture. The two free ends of the suture are passed through the eye so that the loop can be utilized at a later step of the operation to draw the tendon downward without the necessity of knotting. Even a small knot is bound to traumatize very much more than the smooth loop. The probe is drawn entirely through the sheath leaving the guide suture in place.

The third incision must be a long one, since the peroneal tendon must be exposed up to the middle of the calf if it is to be given the proper line of traction. A common mistake is to free the tendon only a short distance above the external malleolus thus rendering its course transverse rather than vertical. Its action under such circumstances is just the opposite of that required; it everts the foot instead of inverting it. The incision runs from the middle of the calf downward to the external malleolus, around it, and down to the cuboid bone. It is made slightly S-shaped, the upper part of the incision nearer to the tibia, the lower part near the fibula. This is done so as to facilitate the execution of the fascial plastic. The skin and subjacent tissues are retracted from the underlying fascia until not only the peroneal muscles but also the muscles of the anterior fascial compartment are visible. A longitudinal slit is made in the fascia over the anterior compartment and over the lateral compartment (Fig. 2). Depending upon the age of the patient, these openings in the fascia should be from 2 to 3 inches long. With a little practice it is easy to estimate their length correctly. At each end of the longitudinal slit small transverse incisions are made to permit the eversion of the fascia (Fig. 3). The object of this procedure is to evert the deep layer of the fascia which is coated with paratenon or gliding tissue, and over this gliding tissue the peroneal tendon can be made to pass from one fascial compartment into the other. If this were not done adhesions would almost certainly occur, since traumatism to the fascial septum, as shown both experimentally and in secondary operations, gives rise to adhesions which would impede the gliding of the tendon. The two fascial edges are united by means of a fine silk suture inserted in much the same way as the serosa stitch of a gastro-enterostomy. It is very important that the surface of the fascia coated with gliding tissue, be entirely untouched by any instrument or gauze. Only

the edge which is inverted by the stitch is grasped by the forceps. The suture itself when properly inserted, does not show at all. I have found the Cushing modification of the Lembert suture more practical than any other. Instead of tying the suture at the lower end of the fascial flap, it is advisable to take an additional stitch so as to tie at a somewhat lower point and thus avoid any possible contact of the tendon with the knot.

The eye probe must now be passed from the upper pole of the tibialis sheath beneath the fascia and out in the region of the fascial plastic. The upper end of the guide suture lying in the tibialis sheath is drawn beneath the fascia by means of the probe. The guide suture thus runs from the fascial plastic beneath the fascia cruris into the tibialis anticus sheath, downward through the sheath and out near the insertion of the tibialis tendon. It is everywhere in contact with gliding tissue and by drawing the peroneal tendon along this course, it will make its pathway correspond to the normal. Only after all these preparatory steps is the operator ready to expose the peroneal tendon. The tendon is freed by prolonging the fascial incision already made over its upper end downward until the sheath has been opened and then along the sheath to the groove in the cuboid bone where the peroneal tendon passes into the sole of the foot. It is at this point that the tendon should be divided, since experience has shown that it is then just long enough to reach to its new point of insertion. The tip of the divided tendon is grasped with the tendon clamp (Fig. 4) and a No. 2 chromic suture is inserted as indicated in Figure 5. The ends of the suture are left long to facilitate drawing the tendon downward through the sheath of the tibialis anticus. As rapidly as possible the tendon is now freed up to the lowermost muscle fibers and drawn over the fascial bridge downward through the tibialis sheath (Fig. 3, *b*). While doing this the first assistant must hold the tendon in the air by means of any smooth instrument so as to prevent the tendon from buckling. The operator must grasp the end of the tendon with a forceps and start it on its pathway, since otherwise torsion is likely to occur. This step of the operation, more than any other, requires practice and team play. Its execution ought not to require more than 5 seconds.

Fig. 8 (at left). The effect of transplantation of the peroneus longus through the sheath of the tibialis anticus in a case of severe paralytic flat foot due to paralysis of both tibialis anticus and tibialis posticus. Note the complete absence of planus deformity. Operation June, 1918; photographed July, 1920.

Fig. 9. Same patient as in Figure 8 illustrating the degree of voluntary inversion subsequent to the transplantation of the peroneus longus through the sheath of the tibialis anticus.

The long incision is closed at once to prevent further exposure of the tendon to the air, then the second incision is closed. The operator is then ready to attach the tendon to its new insertion. The ends of the chromic gut suture are passed into a stout cervix needle with which several firm bites are taken through fascia and cartilage. The fixation should be such as to draw the tendon directly against the bed in the internal cuneiform bone already prepared for it. The two halves of the split tibialis tendon are united to the tendon so as to give additional security. This method of fixation meets the demands of mechanical security and also of physiological fixation, since the traumatized bone cells react to hold the tendon secure. To determine the degree of tension under which the tendon should be sutured, the operator has recourse to the rule already referred to, namely, that when under anæsthesia the origin and insertion of a muscle and its tendon are approximated, the tension of the tendon is zero. The foot is therefore inverted and dorsiflexed and the peroneal tendon is pulled upon with just enough force to render its course straight. It will be found that its length, if it has been divided at the cuboid groove, is just sufficient to make it reach the bony implantation site prepared for it.

The operation is concluded by suturing the first skin incision. The foot is then immobi-

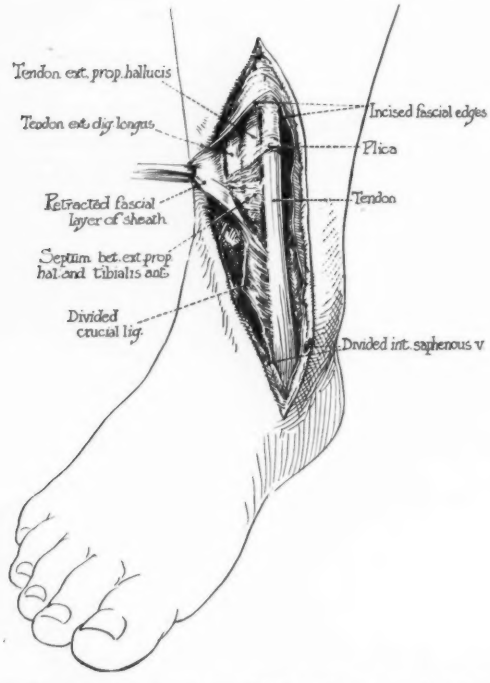

Fig. 10. Transfer of the tibialis anticus to replace the paralyzed evertors of the foot in a case of paralytic club-foot. The drawing illustrates the second incision which exposes the tibialis anticus tendon. The fascia is retracted by a clamp exposing the extensor longus digitorum tendons above their sheath. The probe inserted at this point passes downward along the tendons into the sheath of the extensor longus digitorum and out near the insertion of the peroneus tertius. (From Mayer, *Orthopedic Treatment of Gunshot Injuries.*)

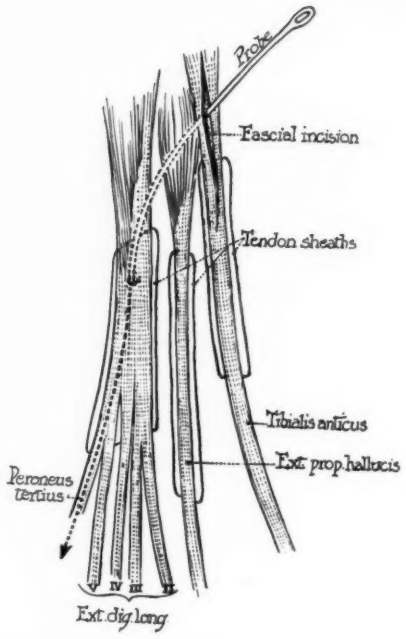

Fig. 11. Diagram illustrating the passage of the probe through the sheath of the extensor longus digitorum for the transference of the tibialis anticus to the outer side of the foot. The dotted line and the arrow indicate the direction of the probe through the sheath and its emergence at the insertion of the peroneus tertius.

lized in plaster-of-Paris in a position of inversion and dorsiflexion.

2. *Paralytic club-foot.* Transplantation of the tibialis anticus is done to replace the evertors of the foot. A horseshoe-shaped incision is made over the insertion of the peroneus tertius, the skin flap being directed upward. The tendon of the peroneus tertius is split at its insertion and a groove cut in the fourth and fifth metatarsal bones for the reception of the tibialis tendon.

The second incision is made along the course of the tibialis anticus tendon from a point slightly proximal to the upper pole of the sheath downward to its insertion. The fascia is incised just above the sheath and is retracted toward the outer side of the leg so as to expose the extensor proprius hallucis and the extensor longus digitorum (Fig. 10). An eye probe threaded with a guide suture is now passed downward along the course of the extensor longus digitorum tendons and made to enter its sheath (Fig. 11). This is a simple procedure if the operator is careful to make the tip of the probe hug the tendon. This is best done by making a small hole in the paratenon which surrounds the tendons into which the tip of the probe is inserted. On entering the sheath the probe finds its way readily downward and is made to emerge over the peroneus tertius tendon which runs through the same sheath as the long extensor (Fig. 11). The probe is pulled through bringing the guide suture after it. The tibialis anticus sheath is split open its entire length and the tendon cut away at its point of inser-

tion. Unless the full length of the tendon be secured, it will prove too short to reach to the outer side of the foot. It is advisable to take a small bit of cartilage or bone with the tendon since this renders the union at the new point of implantation particularly firm. The tendon is threaded with the usual fixation suture, freed from its mesotenon and by means of the guide suture drawn downward through the sheath of the extensor longus digitorum and made to emerge at the insertion of the peroneus tertius. Here it is fastened to the groove already made in the bone. The operation is concluded by suturing fascia and skin. The leg is immobilized with the foot in maximum eversion and dorsiflexion.

In mild cases of club-foot the extensor proprius hallucis may be used instead of the tibialis anticus. The operation is performed in exactly the same manner.

3. *Paralytic cavus* (paralysis of the gastrocnemius and soleus). Transplantation of the peroneus longus or brevis combined with that of flexor longus hallucis is done to replace the paralyzed Achilles tendon. This operation is indicated in cases of moderate cavus deformity. When the cavus deformity is marked, bone operations, either astragalectomy or the Jones operation, are necessary.

After a preliminary division of the plantar fascia, of the plantar muscles and if necessary of the long plantar ligaments, the foot is wrenched thoroughly so as to restore the normal form. Two transverse incisions are made over the back of the heel excising an ellipse the width of which is dependent on the amount of redundancy of the skin. Sufficient skin should be excised to draw the heel toward the knee with all the traction that the suture line can stand. Through the two lateral projections of this elliptical incision, the peroneal tendons are exposed on one side and the flexor longus hallucis tendon on the other.

The peronei are easily found but the long flexor of the toe lies buried beneath a fascial plane which holds it close against the groove in the astragalus (Fig. 14). The large vessels and the posterior tibial nerve should be drawn forward until this fascial band is exposed and only after its incision will the tendon become visible. The tendons are cut off as low as possible, threaded with the usual fixation suture, drawn through a slit in the Achilles tendon and fastened firmly to the os calcis which has been grooved for their reception as in the previous operations.

Fig. 12 (at left). Paralytic club-foot before treatment.
Fig. 13. Same patient as in Figure 12 one year after transplanting the tibialis anticus through the sheath of the extensor longus digitorum to replace the paralyzed evertors of the foot. The transplanted tendon functions with sufficient strength to maintain normal muscle balance.

The wound is closed by interrupted sutures with sufficient tension to draw the tuberosity of the os calcis upward toward the knee. In putting on the plaster it is advisable to fix the heel in this position and after this first part of the plaster has hardened, to apply a second portion in which the forefoot is forced dorsalward so as to correct the cavus deformity.

4. *Paralysis of the extensors of the knee.* To correct this condition transplantation of the hamstring muscles is done. In this operation the sheath method is not feasible since the tendons at the knee, unlike those at the foot, are not equipped with a sheath. This is due to the fact that with the exception of the quadriceps, the tendons run approximately a straight course and a sheath is a physiological necessity only when the tendons change their direction. In the case of the quadriceps tendon the knee-joint and the quadriceps bursa take the place of the sheath. The technique of the operation, therefore, is quite different from that employed in the operations about the foot. At the same time, it varies sufficiently from the older operative methods, in certain important details, to justify its inclusion in this sytem of tendon transplantations.

The site of implantation is first prepared by a longitudinal incision extending from a point 2 inches above the patella vertically downward to its lower pole. A small vertical incision is made from the upper border of the

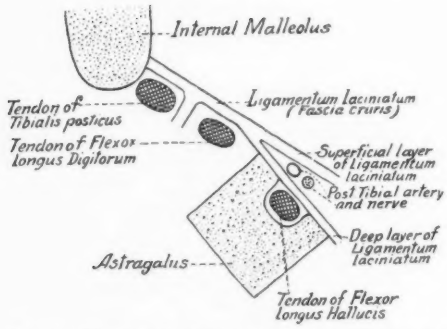
Internal Malleolus
Tendon of Tibialis posticus
Ligamentum Laciniatum (Fascia cruris)
Tendon of Flexor longus Digitorum
Superficial layer of Ligamentum laciniatum
Post Tibial artery and nerve
Deep layer of Ligamentum laciniatum
Astragalus
Tendon of Flexor longus Hallucis

Fig. 14. Diagram illustrating the fascial planes covering the tendon of the flexor longus hallucis at the ankle. To expose the tendon the superficial layer of the deep fascia (ligamentum lacinatum) must be incised, the posterior tibial artery and nerve drawn toward the ankle and then the deep layer of the fascia opened before the tendon is exposed to view. (From Mayer, *Orthopedic Treatment of Gunshot Injuries.*)

patella to about its middle and a corresponding horizontal incision along the superior border. Two little flaps are thus outlined which are retracted together with the superficial bone layers thus exposing the raw surface of the patella against which the implanted tendons are to be brought (Fig. 16). The second step of the operation consists in reefing the paralyzed quadriceps tendon by means of two mattress sutures. The purpose of this procedure is to pull the patella as far upward as possible so that when the transplanted muscles begin to contract, their full force will be exerted at once to extend the calf instead of expending part of their energy in first pulling the patella upward.

The patient is then turned on the side and a long incision is made exposing the biceps tendon from a point almost half way to the hip down to the head of the fibula. Before freeing the tendon, the external popliteal nerve must be found and drawn out of the way. In cutting away the tendon from its insertion, care must be taken not to injure the external lateral ligament of the knee-joint which it will be remembered, also inserts into the head of the fibula. The tendon and muscle must be freed until its course, when transposed, will be an oblique one and not transverse. The more vertical the pull of the transplanted muscle, the more effective it will be and the sacrifice of a few muscle fibers is more than outbalanced by the increased mechanical efficiency secured by the proper line of traction. The tendon is drawn forward through a subcutaneous channel previously made by means of a stout dressing forceps. The channel must be sufficiently wide to allow free passage and the muscle itself must not be twisted during the transfer.

The biceps is not anchored to the patella at once but before this is done, the patient is again turned so as to expose the inner side of the thigh and through a third incision, the inner group of hamstring muscles is exposed. Any one of these, except the semimembranosus, is suitable.

The operator selects whichever muscle seems most suitable, frees it a sufficient distance upward to make its course straight and brings it forward through a subcutaneous channel similar to that already made for the biceps. The two transposed tendons are then cut off equal in length. Each is threaded with the usual fixation suture and then anchored securely to the patella in such a way as to rest against the raw bone-area already prepared for it. The retracted periosteal flaps are united over the tendons thus pressing them firmly against the bone (Fig. 17). Several stitches are taken above the implantation site holding the two tendons together. This renders the resultant pull almost a vertical one and thus approximates the action of the paralyzed muscle. The operation is concluded by the usual continuous skin sutures.

5. Inoperable musculospiral paralysis. Transplantation of flexor carpi radialis, flexor carpi ulnaris and sometimes of the pronator radii teres to the dorsum of the hand for drop wrist. The operation is a complicated one and cannot be considered as reliable as those already outlined, owing to the fact that some of the transplanted tendons have to be attached to the paralyzed tendons instead of directly to the bone. The details of the operation vary somewhat depending upon whether or not the pronator radii teres is used. I shall first describe the operation when the pronator is not employed.

The insertions of the extensor carpi radialis longior and brevior are first exposed by means

Fig. 15a.

Fig. 15b.

Fig. 15, *a* and *b*. These photographs illustrate the effect of transferring the peroneus longus and flexor longus hallucis to replace the paralyzed gastrocnemius and soleus. Before the operation there was a marked degree of cavus and total inability to hold the body weight on the toes. Note the normal form of the foot and the ability of the patient to stand on tip-toe.

of a 2 inch curving incision on the dorsum of the hand. One of the tendons is slit longitudinally and the bone grooved for the reception of the tendon to be transplanted. A second small incision is made just above the annular ligament and a probe passed upward through the sheath of the extensor carpi radialis is made to emerge at this point. If the sheath is found sufficiently roomy to permit the passage of the tendon to be transplanted, a guide suture is drawn through it. If, however, the room is scanty, one of the extensor tendons is withdrawn from the sheath after cutting it off about 1 inch from its insertion. The second incision about 6 inches long on the anterior surface of the arm exposes the flexor carpi radialis tendon. The incision must pass far enough downward to allow the division of the tendon where it is passing through the bony canal of the trapezium, since this is the requisite length of tendon to reach the new site of implantation. The tendon is drawn subcutaneously to the upper pole of the extensor carpi radialis sheath, downward through the sheath, and fastened to the metacarpal bones by the usual fixation method.

Through the small incision at the upper part of the extensor carpi radialis sheath, the long extensor tendon of the thumb is next exposed. Through a third incision over the ulnar aspect of the arm, the flexor carpi ulnaris is found, freed, and drawn to the dorsum of the hand where it is united to the long extensor of the thumb. The suture may be either by means of the Bunnell method or, owing to the fact that the tendons overlap, the thumb tendon may be drawn through a slit in the flexor and united to it by means of several interrupted sutures (Fig. 18). When the operation is performed by this method, complete extension of the fingers is not secured, but an excellent

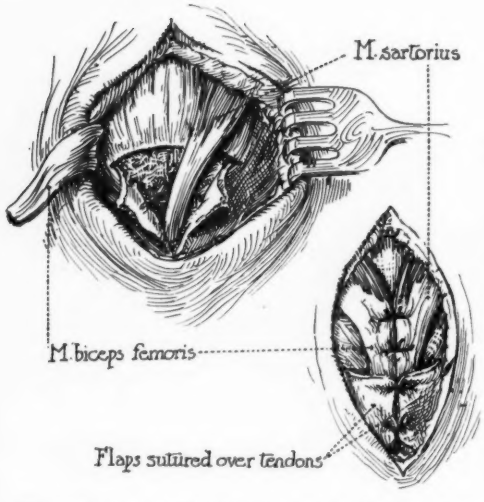

Fig. 16 (at left). This illustrates the method of reflecting the osteoperiosteal flaps from the surface of the patella preparatory to the implantation of the hamstring tendons.

Fig. 17. This illustrates the suture of the osteoperiosteal flaps over the transplanted hamstring tendons after their attachment to the patella. The flaps hold the tendons firmly against the raw bone surface and insure firm union. The tendons are united to one another above the patella so as to make the line of traction as nearly vertical as possible. (From Mayer, *Orthopedic Treatment of Gunshot Injuries.*)

functional result ensues owing to the good dorsal flexion of the wrist and to the fact that the lumbricals and interossei extend the two distal phalangeal joints.

When the pronator radii teres can be transplanted also, a full extension of the fingers can be secured by utilizing the flexor carpi radialis for the extensor communis digitorum tendons. The pronator radii teres is attached directly to the extensor carpi radialis longior and brevior tendons near its point of insertion. The flexor carpi ulnaris is sutured to the long extensor of the thumb as in the preceding operation.

6. Transference of the flexor sublimis tendon to replace the divided flexor tendons of an adjacent finger. This operation is indicated when, owing to extensive gunshot injuries, the destruction of the tendons is so great and the scar-tissue formation so dense as to prevent the union of the tendons by the bridging method to be outlined in the next section.

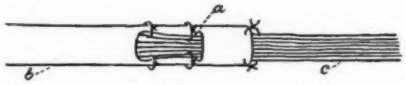

Fig. 18. This diagram illustrates the suture of tendon to tendon when overlapping is possible. Tendon *c* is drawn through a slit in tendon *b* and fastened to it by means of fine chromic gut sutures.

The results, although not perfect, have been satisfactory.

The distal ends of the divided tendons are first exposed by means of a one and one-half inch curving incision. The flexor profundus is identified and threaded with the Bunnell suture. The flexor sublimis tendon of the adjacent finger is next exposed by a 3 inch vertical incision, the tendon cut away at a point sufficiently far distal to allow it to reach to the divided flexor profundus tendon. It is drawn downward beneath the skin to the injured tendon, threaded with the usual suture and united to it with just sufficient tension to render it taut when the finger is straightened out. The divided flexor sublimis is not sutured since I have found that this tends to impede rather than to assist the more important action of the flexor profundus.

7. Transfer of the extensor communis digitorum tendon of the index finger to replace the divided extensor tendon of the thumb, middle, ring, or little finger. This operation corresponds to that already described for the flexor tendons. The indication is also given by extensive gunshot injuries in which the free transplantation of tendon is impossible because of dense scars adherent to the bone. The distal end of the divided tendon is first exposed and freed from the surrounding tissues for about one-half inch, then a second incision is made along the extensor tendons of the index finger in their course over the metacarpal bone. The more superficial of the two tendons, namely, that of the extensor communis digitorum is freed from the deeper tendon (extensor indicis). The tendon is cut off at a point sufficiently distant from the wrist to allow it to reach to the distal stump of the divided tendon. It is passed through a subcutaneous channel and fastened to the severed tendon either by the Bunnell stitch or else by overlapping.

Fig. 19*a*. Double photograph (two exposures on one plate) illustrating the range of active motion at the ankle subsequent to the insertion of free tendon transplants to bridge the gap between the divided dorsal flexors of the foot. The tendons function with almost the normal strength and the patient walks without a limp. Operation February, 1920; photographed November, 1920.

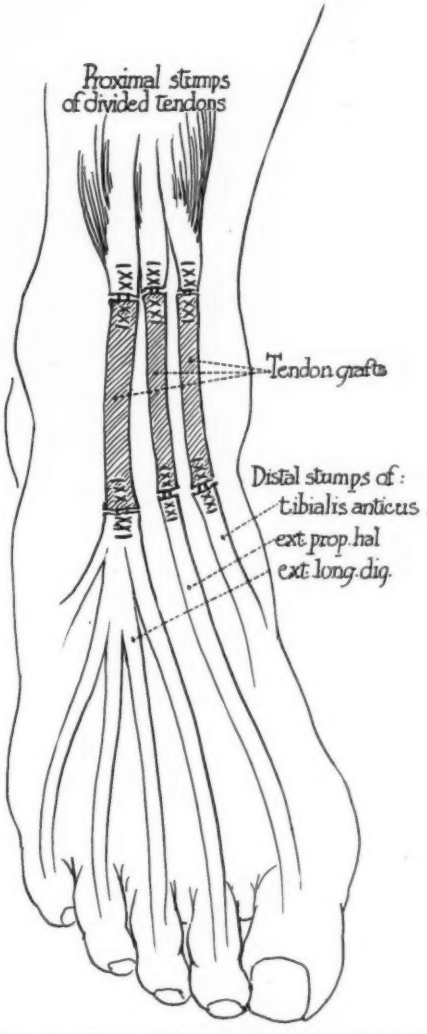

Fig. 19*b*. Diagram illustrating the implantation of tendon grafts taken from the peroneus longus muscle to bridge the gap between the divided tendons on the dorsum of the foot. Each graft about 3 inches long was sutured to the tendon stumps by means of fine chromic gut. The channel for the reception of the grafts corresponded accurately to the normal situation of the tendon sheaths.

GROUP II.—"FREE" TRANSPLANTS

Free transplantation of tendon. (Tendon grafts) Operations of this type are comparatively rare. The usual indication is a marked retraction of the ends of a tendon subsequent to its accidental division. In recent cases of traumatic division of a tendon, it is comparatively easy to secure end-to-end approximation of the stump; several weeks or months after the accident the contraction of the muscle has become so great that it is impossible to coapt the tendon ends, and a bridging operation becomes necessary. For grafting purposes I have used the palmaris longus or a portion of the flexor carpi radialis in operations on the hand; the peroneus longus in foot operations. Bunnell recommends the tendons of the extensor brevis digitorum. No operation in the domain of surgery, not excepting nerve or arterial suture, calls for more delicate manipulation. Bunnell's phrase "atraumatic technique" is particularly applicable to these tendon grafts. Two illustrative cases are as follows:

CASE 1. Jean K., 4 years old, while walking through a hay field was run down by a mowing machine which divided all the dorsal muscles of the right foot just at the level of the ankle. Owing to infection of the compound fracture, operative procedure was contra-indicated until 4 months later. At that time the foot was in marked equinus, there was no power whatever of the dorsal muscles. At the operation the distal tendon ends were first found by means of a curving incision made over the dorsum of the foot. As in operations on divided nerves, the tendons should be identified in healthy tissue and then traced toward the point of their division.

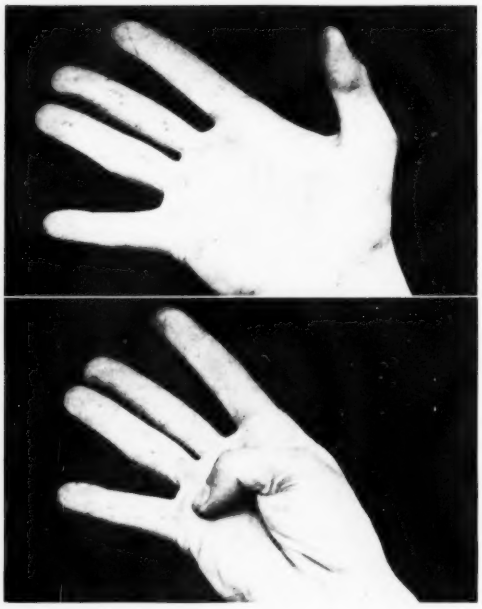

Fig. 20, *a* and *b*. These photographs illustrate the range of active motion of the thumb a year and one-half subsequent to the implantation of a tendon graft bridging the gap between the divided ends of the flexor longus pollicis tendon. Injured October 7, 1918, operated upon December 13, 1918, photographed June, 1920.

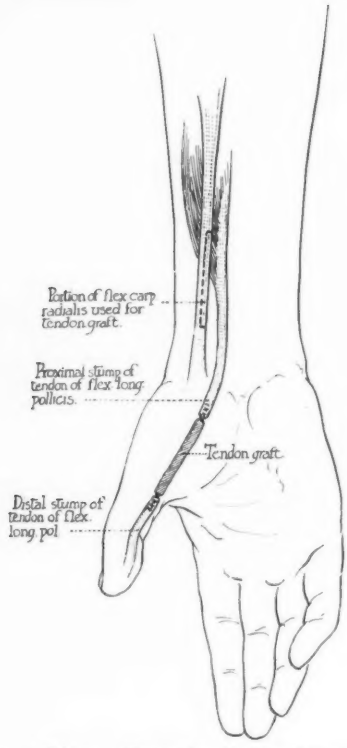
Portion of flex carp radialis used for tendon graft.
Proximal stump of tendon of flex long pollicis.
Tendon graft.
Distal stump of tendon of flex. long pol.

Fig. 20*c*. Diagram illustrating the insertion of the tendon graft in the case illustrated by the preceding figures 20, *a* and *b*).

The corresponding proximal ends were then located through a second incision 2 inches above the ankle. A gap of 3 inches separated the tendon ends. Using the Bunnell tendon clamp, each of the tendons was threaded with No. 1 chromic gut, then the peroneus longus was exposed and from it pieces 3 inches long were excised, threaded with the same type of stitch, and drawn downward through channels previously made connecting the proximal and distal tendon ends. In drilling these channels they were made to follow the course of the tendon sheaths. Each one of the peroneal transplants was united above and below to the corresponding tendon ends (Fig. 19, *b*) and the leg immobilized in dorsiflexion of 90°. The result of the operation is shown in Figure 19, *a*. The sutured tendons 3 months after the operation were functioning with considerable force and at the present time, 9 months after the operation, the child walks without a limp.

Case 2. Mr. H., a druggist's clerk, cut the long flexor tendon of the thumb near the metacarpophalangeal joint. Owing to the death of his wife during the influenza epidemic, he neglected treatment until 2 months later. There were then typical symptoms of complete division of the flexor longus pollicis tendon. At the operation, the distal end of the tendon was first sought through a one inch curving incision just distal to the scar. The proximal end could not be found until a second incision was made running from the annular ligament downward one and one-half inches. The two tendon ends were separated by a gap of two and one-half inches. Using the Bunnell clamp each end was threaded with Pagenstecher linen. Since the palmaris longus tendon was not present, a portion of the flexor carpi radialis tendon was split off longitudinally to use as a graft. By following the natural cleavage lines of the tendon, a rounded, comparatively smooth bridge of tendon was secured. At each end this was threaded with a Pagenstecher linen stitch and drawn downward through the sheath of the flexor longus pollicis which was found to be patent almost its entire length. The transplanted tendon was firmly united to the divided tendon at each end (Fig. 20, *c*), and the thumb immobilized in a semiflexed position. Although the subsequent healing was marred by the discharge of one of the Pagenstecher sutures, firm union of the tendon occurred and complete restoration of function (Figs. 20 *a* and *b*).

GROUP III.—TENDOLYSIS

Tendolysis for adhesions. This operation is indicated in cases in which the continuity of the tendons has been preserved but in which motion is prevented by adhesions. A typical instance is the following:

Mr. B. injured the tendons of the little finger some 2 years before I saw him, and as a result was unable to move the little finger except at the metacarpophalangeal joint. Here a dense transverse scar was found which so far as could be determined bound down the tendons to the bone. At the operation, a 3 inch incision was made along the ulnar side of the little finger and the skin flap was retracted until the tendons were exposed above and below the scarred area. On opening the distal portion of the tendon sheath, the tendons were found to be free from the middle phalanx distalward but densely adherent both to one another and to the bone over the entire proximal phalanx. Proximal to the metacarpophalangeal joint, the tendons were free. As the operation was conducted under local anæsthesia it was simple to test the patient's ability to move the tendons, by asking him to flex the finger. This was quite impossible until the tendons had been dissected away from the bone. He was then able to bend the finger about 75 per cent of the normal. The tendons where they had been adherent, had lost their typical appearance and resembled thin bands of scarred fascia. They were about one-third the normal size. To increase their strength as well as to ensheath them with a smooth layer of gliding cells, a strip of fascia taken from the arm, long enough to cover the scarred area of tendon, and of sufficient width completely to encircle the tendons, was wrapped around them and held in place by means of a running stitch which fastened it securely to the injured tendons. The smooth gliding surface of the fascia was turned outward to form a layer corresponding to the gliding cells of the normal tendon. The result indicated in Figure 21 shows about 75 per cent of the normal motion of the finger.

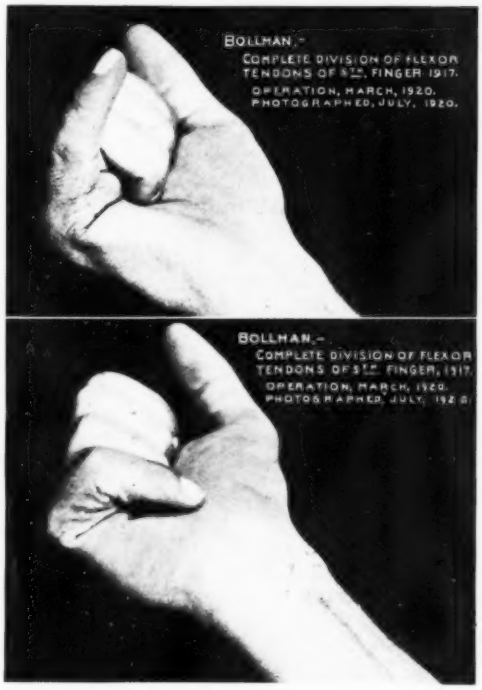
BOLLMAN.-
COMPLETE DIVISION OF FLEXOR TENDONS OF 5TH. FINGER 1917.
OPERATION, MARCH, 1920.
PHOTOGRAPHED, JULY, 1920.
BOLLMAN.-
COMPLETE DIVISION OF FLEXOR TENDONS OF 5TH. FINGER, 1917.
OPERATION, MARCH, 1920.
PHOTOGRAPHED, JULY, 1920.

Fig. 21, *a* and *b*. These two photographs illustrate the range of motion of the fifth finger 4 months subsequent to tendolysis. The tendons of the fifth finger were freed from the bone to which they were adherent and surrounded by a fascial transplant whose gliding surface was turned outward to prevent the formation of adhesions subsequent to the operation.

AFTER-TREATMENT

In previous publications I have tried to emphasize the importance of the after-care in cases of tendon transplantation. Even the best operation will prove a failure unless the transplanted tendons are properly exercised, and I have made it a practice to operate only when the entire treatment can be carried out under my direction. The period of immobilization should not, in a case of transplantation on the foot, exceed 3 weeks; for operation on the fingers, not more than 2 weeks. During the immobilization period the limb should be splinted in such a way as to relax all tension on the structures operated on. After the expiration of this preliminary immobilization, active motion of the muscles involved should be begun. Passive motion and massage is of comparatively little significance. It is, therefore, unwise to operate on children who are so young as to be unable to co-operate. In teaching a patient to use a tendon which has been operated on, a little ingenuity is required to bring out the desired result. Thus, after the transfer of the peroneus longus for paralysis of the tibialis anticus, the tendency of the patient is to utilize the extensor longus digitorum instead of the transplanted muscle. The masseuse must teach the patient to relax the common extensor of the toes which is best done by asking him to lift the big toe, while the other toes are held flexed. In this way the

inner border of the foot is raised without the everting action caused by the extensor longus digitorum. Children learn the trick very soon, when they are instructed correctly.

After transferring the biceps to replace a paralyzed quadriceps, the best preliminary motion is to ask the patient to pull the patella toward the hip. After this can be done, the patient is held in an upright position and the attempt is made to lift the leg forward with the knee extended. Within a very few weeks the patient will learn to use the transplanted hamstring muscles as extensors of the knee.

In working with the fingers, the problem is particularly hard since adhesions tend to develop very rapidly. The immobilization period must therefore be made shorter and consequently the healing process is not as complete. In addition to the suitable active exercises the use of little celluloid splints holding the finger at varying angles is helpful in overcoming the natural stiffness. Hot water baths are also of some value, but the essential factor is the active co-operation of the patient in breaking down the adhesions, which, despite every refinement of technique, are almost certain to develop.

When the transplanted tendons have been taught to function, they still require the surgeon's attention, since their strength is almost never equivalent to that of the structures they are replacing. They must be guarded against undue strain by a suitable splint and further strengthened by systematic exercises.

Prognosis

The prognosis in tendon operations depends almost altogether upon the type of operation. Certain operations should give almost 100 per cent good results, others, not more than 50 per cent. To those giving a high percentage belong the tendon transplants on the foot in which either the peroneus longus or the tibialis anticus is shifted from one side to the other. During the last 3 years I know of only four cases in which these operations have not been successful. In all four instances, a definite cause for failure was ascertainable; in two (transfer of peroneus longus to replace a paralyzed tibialis anticus) the period of immobilization was unduly prolonged because the parents failed to bring the children to the clinic on the appointed day; in two, the transplanted muscle (in one instance the tibialis anticus, in the other, peroneus longus), was too weak owing to its own partial paralysis to do the work expected of it. This percentage of good results does not imply a perfect gliding of the transplanted tendon nor a perfect restitution of the function of the foot; it does mean that the transplanted tendon has sufficient voluntary motion to approximate the action of the paralyzed tendon, and that, though the normal strength of the foot is not regained, the muscle balance is restored (Figs. 6, 7, 8, 9, 12, and 13).

In the third tendon transfer described for the foot (peroneus longus and flexor longus hallucis to replace the paralyzed gastrocnemius and soleus), a normal gliding of the tendons may be expected in all instances. The grave objection to the operation is that the strength of the paralyzed muscles is normally so much greater than that of the two replacing muscles, as to render a complete restoration of muscle balance impossible. The patient is, however, enabled to rise on the toes (Fig. 15) and to walk with a scarcely perceptible limp; running and leaping is impossible.

The operation at the knee is not as perfect technically as the foot operations, but the functional results have been quite satisfactory. In all cases the patient was able to extend the paralyzed leg when standing and in some instances even when lying down. In all cases the gait was much improved.

The tendon transfers on the hand are still less certain procedures, since, instead of attaching the transplanted tendon to the bone, it must be fastened to another tendon. Though this type of union is never as firm as the bony, the period of immobilization may not be prolonged since otherwise adhesions would develop. Despite this inherent difficulty, about 75 per cent good results may be expected.

Of the free tendon grafts I have not done a sufficient number to warrant percentage figures. In the single instance in which grafts were implanted for defects in the tendons on the dorsum of the foot, the result was excellent (Fig. 19, *a*) and in two finger cases, equally good. In two other finger cases, however,

the motion of the implanted tendon was unsatisfactory. These two failures were probably due to the dense scar tissue through which the tendon had to pass. A preparatory operation (Bunnell) in which a fat pad is inserted to replace the scar will probably raise the proportion of successes in cases of this type.

Tendolysis may be expected to restore 50 to 75 per cent of the normal motion of the finger. In these cases as well as in all finger operations, a great part of the success depends upon the co-operation and zeal of the patient, since it is only through the voluntary contraction of the affected muscle that the tendon can be made to glide. No form of passive motion or massage is of any avail. Electrical stimulation may help, but it never gives as great a range of motion as that produced by the voluntary effort of the patient.

SUMMARY

In the development of the physiological method of tendon transplantation, lies an unusual opportunity for the application of a rational surgical technique to paralytic and traumatic conditions. The essential principle of the method is the correlation of each step of the operation with the known facts of tendon anatomy and physiology, in particular the retention of the normal gliding mechanism of the tendon. Applied to the residual paralyses of poliomyelitis and of gunshot injuries as well as to traumatic injuries, the method has yielded consistently good results. It must be emphasized, however, that the operations are technically difficult, that they require intimate knowledge of the finer details of tendon anatomy and considerable practice on the cadaver. Furthermore, that in the postoperative care as well as in the proper selection of cases, attention to detail is as important as in the execution of the operation.

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(A full bibliography covering the subject of tendon surgery can be found in the April, 1916, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, p. 481.)

CYSTS OF THE MESENTERY

By RALPH M. CARTER, A.B., M.D., F.A.C.S., Green Bay, Wisconsin

SOME months ago, the following case came under my observation, and the comparative rarity of the condition, taken with the difficulty in making a differential diagnosis in this particular case, would seem to warrant a report, together with a short discussion of the general subject of mesenteric cysts.

E. C., an Indian school girl of 11 years, was brought into the hospital suffering with acute abdominal pain. She had been taken ill the previous night with sudden intense pain, profuse vomiting, and gradually rising temperature. The pain, at first generalized, had gradually become localized in the right iliac fossa, later again becoming generalized as the abdominal distention progressed. Immediately previous to the attack, her health had been apparently good, and she had been attending school daily. About the age of 7, however, she had an attack resembling the present one, although not so severe, at which time she was sick 3 or 4 days. Otherwise her previous history was negative.

Physical examination revealed a well-developed and well-nourished girl, who appeared to be in great pain. The tongue was coated. The heart and lungs were negative. The abdomen was moderately distended, with marked muscular rigidity. It was so intensely tender that the slightest touch caused her to cry out with pain. To the right of the umbilicus, and extending below it and upward toward the liver, along the rectus border, was a pronounced bulging, apparently fixed, and dull on percussion.

The temperature by mouth was 101.6°, the pulse 136, and the respiration 36. The leucocyte count showed 21,000 white cells, with 90 per cent polymorphonuclears. The urine was clear, acid, specific gravity 1,022, and contained neither albumin nor sugar.

There seemed to be no doubt but that I had to deal with an appendiceal abscess, and preparations were made for an immediate operation.

Under ether anæsthesia, a right rectus incision was made. Upon opening the peritoneum, the omentum was found to be much inflamed and adherent to a mass about 8 centimeters in diameter, lying to the right of the spinal column, and adherent to the posterior wall of the abdomen. After walling off with packs, the tumor was gently freed by finger dissection, following the lines of cleavage, and finally delivered, when it was found to be a cyst, lying in the mesentery of the ileum, immediately adjacent to the ileocæcal junction, and so close to the colon as to appear at first sight to be a part of it. The colon immediately adjacent was much inflamed. The appendix was free, and while it shared in the general inflammatory reaction of the tissues in the neighborhood, there was no true appendicitis, as the term is ordinarily understood. The omentum was everywhere much inflamed, and adherent to the cyst. After freeing all adhesions, the cyst was shelled out and removed. It lay between the two layers of the mesentery, which was much thickened. The space left by its removal was obliterated by catgut sutures, the appendix was removed, and the abdomen closed without drainage. Recovery was uneventful, and the patient left the hospital on the tenth day, and has since remained well.

An examination of the specimen showed a cyst 8 centimeters in diameter, containing a clear straw-colored fluid. Upon opening it, it was seen to consist of two equal-sized loculi, connected by a minute opening. The inner lining was smooth, resembling a serous membrane. It is to be regretted that no microscopical examination of the cyst wall was made, neither was any analysis made of the fluid.

Mesenteric cysts are rare, or at least have been so considered; in the past few years, however, reports of cases have been appearing more frequently in the literature. They are found most often in the mesentery of the small intestine, and usually near the ileocæcal valve, although they may occur in any part. Rokitansky is usually regarded as the first to call attention to the condition, in the year 1842. Since that time, there have been between two and three hundred cases reported, including all varieties.

There are no signs or symptoms which are pathognomonic of mesenteric cysts. According to Porter, pain is more frequent with this condition than with any other type of abdominal cystic tumor. A history of repeated attacks of abdominal pain, associated frequently with vomiting, and often with alternating periods of diarrhœa and constipation, is highly significant. These attacks are presumably due to increased peristalsis, in an effort to overcome the narrowing of the bowel produced by the encroachment of the cyst upon its lumen; they may also be due to attacks of partial volvulus. This narrowing may occasionally be so great as to cause absolute obstruction; a volvulus may also become

complete. Strangulation and gangrene of the gut due to pressure have occurred.

The tumor, especially if situated in the mesentery of the small bowel, and if it has not become the seat of an inflammatory process, with the production of adhesions, is characterized by its extreme mobility, both laterally and, also to a lesser extent, longitudinally. Of course, this would not apply to a tumor completely filling the abdominal cavity. It is frequently surrounded by an area of gas-filled bowel, which gives a resonant note on percussion; occasionally a distended loop of bowel may cross the anterior aspect of the cyst, giving rise to a band of resonance surrounded by a dull area.

The X-ray may be of great value in certain cases, by showing the relationship of the tumor to the lumen of the bowel, and the amount of narrowing from pressure.

That the diagnosis of mesenteric cysts is difficult, is proved by the fact that no case has been recognized with certainty previous to operation or autopsy. Small cysts may give rise to no symptoms whatever, unless, for some cause or other, an acute inflammatory condition arises, as in my own case. Under these circumstances, acute appendicitis, volvulus, intussusception, rupture of a peptic ulcer, cholecystitis, rupture of an extra-uterine pregnancy in the female, in fact, any or all of the acute abdominal conditions must be considered, and any of these conditions may be so closely simulated that an exact diagnosis will be impossible. As the cyst becomes larger, forming a definite tumor, ovarian cysts, retroperitoneal growths, enormous hydronephrosis, movable kidney, pancreatic cysts, new-growths of the intestine, the pregnant uterus, ascites due to tuberculous peritonitis or cirrhosis of the liver, are all to be thought of. Some of these can be easily ruled out, if ordinary care and intelligence be used in the examination; with others, differentiation is more difficult. However, especially with cysts of moderate size, *having the condition in mind*, the diagnosis should be made more frequently, if due attention be given to the history, the physical examination, and the interpretation of good X-ray plates. In extremely large cysts, differential diagnosis may be impossible; the same holds true for extremely small ones.

Opinion is not in accord with regard to the origin of these cysts, owing to the fact that few have been observed in a sufficiently early stage of their development; consequently, students of the condition have had to confine themselves mainly to theory. Some authorities, among whom may be mentioned Moynihan and Porter, believe that they may have a multiple origin.

According to this view, Moynihan classifies them as follows:

1. Serous cysts, unilocular or multilocular, containing clear serous fluid, and of which the present case is a type; these are supposed to arise from dilatation of lymph channels, or from hæmorrhages between the layers of the mesentery.

2. Chylous cysts, unilocular or multilocular, containing a milky fluid, supposed to arise from obstruction to some of the lacteals, although so far it has been impossible to produce them experimentally. This variety is probably the most numerous, comprising about one-half of all the reported cases.

3. Hydatid cysts, due to the tænia echinococcus.

4. Blood cysts, probably arising from hæmorrhage into preformed cysts.

5. Dermoid cysts, which are undoubtedly embryonic in origin.

6. Cystic malignant disease, possibly also embryonic in the last analysis.

Dowd believes that the majority of these cysts have an embryonic origin, and he classifies them as:

1. Embryonic;
2. Hydatid;
3. Cystic malignant disease.

By Niosi, the embryonic cysts are still further divided thus:

1. Cysts of intestinal origin—
   a. By sequestration from the bowel during development,
   b. From Meckel's diverticulum;
2. Dermoids;
3. Cysts arising from retroperitoneal organs (germinal epithelium, ovary, wolffian body, muellerian duct).

In this connection, a case studied and reported in great detail by Miller is of great interest. It was that of a four-day-old baby, in which the wall of the cyst was in part directly continuous with that of the jejunum, and the histological structure of which closely resembled that of the bowel. In this case, at least, the enterogenous origin by a process of sequestration during embryonic life seems to be established.

It has also been suggested that some of these cysts may represent an unusual form of tuberculosis of the mesenteric lymph glands.

It is very evident from these various classifications, that our knowledge of the etiology of the condition is far from exact. This is due, in large measure, to the condition found at operation or autopsy. The tumors may vary in size from that of a walnut to enormous cysts filling the abdominal cavity; they may be unilocular or multilocular, and the wall is usually composed of a fibrous membrane of varying thickness, from which all trace of the original histological structure is lost, due to the pressure of the contained fluid. This fluid may be of any character; in addition, it is self-evident that the character may change by reason of hæmorrhage or entrance of infection into the cyst; thus, a serous cyst might readily, and undoubtedly frequently does, become converted into a blood cyst. For this reason, any classification based entirely upon the cyst contents is extremely likely to be misleading, especially when used as a basis for statistics of frequency of occurrence of the various forms.

Moreover, the term "mesenteric cyst" has, in my opinion, been heretofore used to cover too broad a field; a point of view which has also been held and ably discussed by Child, Strong, and Schwartz. For example, a malignant tumor with cystic degeneration occurring in the mesentery, while undoubtedly a "mesenteric cyst," when its location alone is taken as a basis for classification, nevertheless still belongs to the class of malignant tumors. Therefore, it should be classed with these tumors, regardless of its location. The same holds true for dermoids and parasitic cysts. This brings us to the true mesenteric cysts. There is no doubt but that many, if not most, of these true cysts are embryonal in origin; others may arise from Meckel's diverticulum, or from sequestration from the bowel during development; also, from some of the evidence presented, it seems extremely likely that obstruction to the lymphatics or lacteals may result in cysts in certain cases. As a working classification for the study of cystic tumors of the mesentery, I would suggest the following:

1. True mesenteric cysts, subdivided, according to their probable origin, into—
   a. Embryocystomata,
   b. Enterocystomata, by which I understand not only tumors of Meckel's diverticulum, but also tumors arising from sequestration from the bowel,
   c. Obstructive, possibly;
2. Dermoids;
3. Cystic malignant disease;
4. Parasitic.

By applying this classification to all cystic tumors of the mesentery, more uniformity of description would at least be obtained than at present exists in the literature.

TREATMENT

There are five possible methods of dealing with cases of mesenteric cysts: (1) aspiration; (2) marsupialization; (3) incision and drainage; (4) enucleation; (5) if the bowel is affected, resection of the affected portion, with excision of the cyst.

Of these five methods, enucleation, if possible, or excision together with a segment of bowel is the operation of choice. Aspiration has no place in modern surgery, although it was the favorite procedure with the older surgeons. Marsupialization is also obsolete, and properly so, unless in very exceptional instances. Incision and drainage may occasionally have to be resorted to in an acute phase of the disease, when more extended operative procedures would greatly jeopardize the life of the patient, or in the case of an extremely large cyst, or one surrounded by dense adhesions, when enucleation or resection of the bowel is out of the question. Of course, in those cases which have been drained, recurrence is extremely likely. The ideal procedure is enucleation, and in the average case, when the cyst is not too large, this can

be readily accomplished. If the blood supply of the adjacent bowel is markedly interfered with, however, the affected loop must also be resected.

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ACTINOMYCOSIS OF THE CÆCUM[1]

BY F. WEBB GRIFFITH, M.D., F.A.C.S., ASHEVILLE, NORTH CAROLINA

MERELY because in the past year I happened to have had two cases of actinomycosis, or at least one definite and one probable case, would not be sufficient justification for reporting them were it not for the fact that in a surgical experience of 15 years I had not previously seen, or at least had not recognized, a single case. Inquiry among several of my colleagues revealed the fact that they were as ignorant about the subject of actinomycosis as I was. For that reason I am presenting this paper, hoping that we may have a discussion which will help to enlighten all of us.

In 1845, von Langenbeck first discovered the organism to which Harz later gave the name of actinomycosis or ray-fungus.

Bollinger first discovered the disease in the ox and gave it the name of "lumpy-jaw," or big jaw. To Israel is given the credit of discovering the first case in man.

For many years it was uncertain as to how the infecting organism should be classified and some of the types have been erroneously included among the higher bacteria. The yellowish, so-called sulphur granules, about 2 millimeters in diameter, can be readily seen with the naked eye. Microscopic examination shows these granules to be composed of cocci and radiating threads which take the Gram stain.

Schlegel showed that the dried spores germinated after 238 hours of exposure to sunlight. Odermatt described 8 cases of actinomycosis of the mouth apparently contracted from sleeping on straw or hay. In one of the cases he felt convinced that the incubation period had been 8 months.

In the majority of cases the mouth, and especially a carious tooth, seems to be the portal of entry, although involvement of the skin of the neck and head is almost as frequent as of the jaw.

The symptoms are usually those of an extensive ulceration. The process may be progressive and destructive in one area, while an adjacent region is healing by the formation of fibrous tissue.

Apparently actinomycosis does not spread by the blood or lymph, but rather by continuity and contiguity.

Letulle and Hufnagel described a case starting in the œsophagus and spreading directly through to the heart and also to the right pleura and to the base of the right lung. Apparently no structure has the power to resist its invasion.

In the second case I shall report, the lesion apparently started in the jaw, and the cæcum became involved by the organism being swallowed. From the cæcum the infection obviously burrowed through into the loin.

Osler says: "As in tubercle, the first effect is the destruction of adjacent cells and the attraction of leucocytes—later the surrounding cells begin to proliferate. After the tumor reaches a certain size there is great proliferation of the surrounding connective

[1]Read before the North Carolina Section of the American College of Surgeons at Charlotte, North Carolina, January 20, 1921.

tissue and the growth may, particularly in the jaw, look like, and was long mistaken for, osteosarcoma. Finally suppuration occurs, which in man, according to Israel, may be produced directly by the streptothrix itself."

Illich, analyzing 421 cases in man, found the following distributions: skin, 2.67 per cent; lungs, 13.8 per cent; abdominal, 21 per cent; neck, 51.8 per cent. The location of the remaining 11.8 per cent was not stated.

The diseases from which actinomycosis usually has to be differentiated are tuberculosis, cancer, and syphilis.

Pulmonary actinomycosis is evidently very rare as several of the lung specialists of Asheville who have examined thousands of cases with pulmonary diseases tell me that they have not seen, or at least have not recognized, a single case.

Illich found no recoveries in 58 cases of actinomycosis of the lungs, while Mayer found 7 recoveries in 35 cases.

Gourgerot reports 2 cases of cancer wrongly diagnosed actinomycosis. The diagnosis was made from the presence of yellowish granules similating the ray-fungus and in which the filaments took the stain. It was only by microscopic examination of the excised tissue that the correct diagnosis was made.

The Wassermann test would probably differentiate syphilis from actinomycosis.

Report of my cases follow.

CASE 1. Mr. M. M., white, age 31; railway fireman; denies venereal diseases; was admitted to the hospital March 4, 1919. For 4 or 5 months he had had at intervals severe cramps. The attacks at first were more or less vague, extending over entire abdomen, but later localizing in right side. The cramps would last half an hour and until a short time before admission did not necessitate going to bed. There was nausea, but no vomiting. Patient had suffered for many years with constipation. On admission to hospital the heart and lungs were normal, abdomen was normal except for slight tenderness in McBurney region and slight rigidity over right rectus. Urine was normal. On March 5, 1919, through a right rectus incision a chronically inflamed appendix was removed, but was not subjected to microscopic examination. The other abdominal organs were normal. Patient left hospital in 14 days and remained perfectly well for 6 months. At the end of that time he began to have some vague pains in right side of abdomen similar to the pains before operation, only much worse. Attacks became more frequent, often lasting for an hour, with nausea and vomiting. The pain became worse and frequently necessitating remaining in bed 1 to 2 days. The vomiting seemed to bear no relation to the pain and would frequently come 5 or 6 hours after meals. His diet was finally reduced to nothing but thin liquids. I saw him April 1, 1920, for the first time since leaving the hospital a year previous. At this examination patient had obviously lost considerable weight and in the region of the cæcum could be felt a sausage-shaped mass the size of a small banana, and fairly freely movable. Operation the following day showed the tumor in the cæcum. It was fairly hard and one was struck by the large amount of fibrous tissue. There was slight enlargement of the mesenteric glands. There was no tendency to ulceration or breaking down of the tumor. The terminal ileum together with the cæcum and about two-thirds of the ascending colon was removed. The ileum was then anastomosed to the transverse colon. Patient made excellent recovery and since then has been working full time and eating whatever he wants.

X-ray taken recently, 9 months after operation, shows that the anastomosis is functioning well. There is also nothing to indicate a return of the trouble. The tumor was removed under the mistaken diagnosis of malignancy, but the report from Professor Winternitz, professor of pathology at Yale, states that it was probably actinomycosis. I wrote later asking if he was positive of the diagnosis, also how many similar cases he had seen in his large experience and received the following reply:

"I had sections stained by the acid fast and Gram methods, but I am sorry to say that I have been unable definitely to determine the etiological factor of the condition. I still feel that the inflammatory process represented in the intestinal wall is a fungus variety and although an occasional strand or thread, or even a rosette-like function is found, these are not clear enough to be positive diagnostically. I will have more sections made and if new findings present themselves I will let you know."

He also stated that he had seen only two other similar cases, one a specimen sent to him a year ago and the other an autopsy case at Hopkins several years ago showing primary intestinal actinomycosis with subsequent invasion of the liver and abdominal wall.

CASE 2. Mrs. S. H., white, age 38, married. Family history is negative. Patient has had usual diseases of childhood, otherwise perfectly well. She has been married 22 years and has had 9 children and no miscarriages. Since 1909 patient has been living on farm and doing the usual duties of a farmer's wife. About 9 years ago her husband bought a cow, which had "lump-jaw." The cow was sent away in 3 or 4 days. He has had no other cases among the stock.

In the early spring of 1920 patient had abscess of right lower jaw. In about a week the abscess broke

giving her complete relief, but it has reformed several times since. In May, 1920, patient had a severe attack of colic, lasting 2 or 3 days, but she did not go to bed. Had vague pains in abdomen and some indigestion following that attack, but no violent pain until August 28. About midnight of that date she was awakened with acute pain in abdomen, which she described as very much like labor pains. Pain was severe enough to require an opiate and she was kept under the influence more or less until her admission in the hospital 5 days later.

Physical examination on admission to the hospital September 21, 1920. Patient was obviously desperately ill. The heart, lungs, and urine were negative, the abdomen was quite rigid, especially over the right side and across the lower part. The red count was 4,448,000, hæmoglobin 50 per cent, leucocyte count 27,500, Wassermann negative. Pelvic examination showed the uterus anteflexed. A feeling of rigidity and induration in the right fornix. The left fornix was slightly tender. Midline incision showed there was an abscess behind the uterus containing about 3 ounces of pus. The pelvic organs were firmly massed in adhesions. The appendix and cæcum were also bound down in the mass of firm pelvic adhesions. The uterus together with both tubes and ovaries was removed by supravaginal amputation. Three drains were placed through into the vagina. The raw areas were covered over with peritoneum and the cervix suspended by the round ligaments. The necrotic appendix was removed and the cæcum was found to be markedly thickened and friable. The infection apparently started in the cæcum. Patient made excellent recovery and left hospital in 18 days.

On November 14, 7 weeks after she was discharged from the hospital, she was re-admitted with an abscess the size of an orange in the right loin. Her temperature was 105° and pulse 120. The abscess was drained and about 6 ounces of pus escaped. The cavity apparently extended directly forward to the region of the cæcum. At this operation we first recognized the typical yellowish sulphur granules, which microscopically proved to be actinomyces. A few days after this second operation patient developed another abscess of the lower jaw from which the ray-fungus was obtained. The jaw was thoroughly curetted by a dentist and patient was put on potassium iodide, grains 60, three times a day for 4 days. After 2 weeks rest same dosage was repeated. She was given X-ray treatments over the right loin. X-ray showed the lungs were clear. Patient has improved enough to leave the hospital, but is still a long way from being well.

SOME OBSERVATIONS ON CASES OF NONUNION OF FRACTURES IN THE LOWER THIRD OF THE TIBIA

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IT is a well known fact that a great percentage of fractures of the lower third of the tibia result in delay or non-union. It is further generally recognized that fractures elsewhere in the tibia almost invariably result in firm union under similar conditions and circumstances. When one endeavors to determine the cause, attention must be directed to two groups of factors: the extrinsic and the intrinsic.

Under extrinsic factors must be considered treatment as typified by fixation and position. These can be dismissed as having no bearing on the result, as we all know that in some cases of simple fracture with little swelling and slight evidence of trauma, despite good reduction and perfect fixation in good healthy young adults, we get delayed or non-union.

Under intrinsic factors we have as the chief conditions the reduction of the fracture and the blood supply. The accuracy and the absolute perfection of reduction has little or no bearing on the result in this fracture. I think it is generally conceded that union occurs in almost every shaft fracture of a long bone despite overlapping and angulation, provided no substance foreign to the site (such as interposed muscle, loosened displaced bone fragments, shell fragments, bullets, etc.) lies between the ends. The noticeable exceptions to this are neck of femur and midshaft of humerus. Each of these has a definite well known cause. In the fracture of the neck of the femur it is lack of blood supply. In the shaft of the humerus it is faulty fixation and poor blood supply to the lower fragment. In the fracture under consideration we almost never meet interposition of soft parts and rarely in civil life with extraneous foreign bodies. The factor that does seem to be of significance in its peculiarity to fractures in this neighborhood is the anatomy and its blood supply, and the effect that the primary injury, the injury consequent upon forcible reduction and the subsequent prolonged elevation of the limb, has upon this same blood supply.

Anatomy. The soft parts in the lower third of the leg are compactly situated with little areolar tissue between them. The nerves, vessels, and tendons are all enveloped in a sheath of deep fascia that is thick and strong enough almost to be termed an aponeurosis. This fascia permits of almost no stretching; hence any swelling occurring beneath it must of necessity cause pressure upon the contents beneath it. The vessels being the most readily compressible structures are, of course, the first to be affected. Where this fascia remains intact, in fracture cases, the effect of the swelling is noticed in a lessened or softened pulse in the dorsalis pedis artery and a tenseness of the tissues with but little real increase in the total circumference of the limb.

In cases of compound fracture and in those cases where the fascia has been torn, the extravasated blood escapes, the swelling rapidly reduces and the bleb formation, which is an evidence of trophic disturbance, is diminished or even absent. Furthermore in these cases of serious injury, the swelling is widely distributed, is soft, and subsides early, leaving the foot warm and of a natural color.

Blood supply. The arterial supply to the leg is derived from the anterior and posterior tibials. The nutrient artery enters the tibia in its upper third and consequently is cut off from the lower fragment in fractures in the lower third of this bone. In some anatomies the posterior tibial artery is described as giving two or three articular branches to the lower end of the tibia; in other anatomies there is no reference to any posterior tibial branches supplying the lower end of the tibia.

The anterior tibial artery in the lower fourth of the leg lies immediately against the tibia with no intervening muscle protection. It gives off at this level several small periosteal branches to the tibia. At a lower level it gives

off the internal and external malleolar branches which supply the greater portion of the ankle-joint. The writer dissected 18 legs with a view to demonstrating the blood supply of the tibia. The conclusions reached were:

The anterior tibial artery is the source of the greater proportion of the blood supply to the lower end of the tibia.

The anterior tibial artery lies in a position which directly exposes it to injury from bone fragments in lower tibia fractures, which can easily result in thrombosis or even a laceration of the arterial wall itself.

The lower third of the anterior tibial artery lies in a well defined rigid gutter between the bones on either side, the interosseous membrane behind, and the dense deep fascia of the lower leg in front.

Although the arterial anastomosis of the ankle and foot is a very rich one, nevertheless, the lower end of the tibia comes in for a very small portion of it. The posterior tibial probably contributes most to this anastomasis, at least, our experience with wounds of these arteries in the last war would warrant such a statement. When a posterior tibial artery was severed it meant, practically always, gangrene and amputation. This was not nearly so often the case in anterior tibial wounds.

With these facts in mind it can be readily understood what serious effects upon the blood supply of the lower fragments may occur if excessive swelling partially obstructs the artery or the broken bones wound the vessel causing a thrombosis or even a laceration. Some one of these conditions frequently comes to pass as is evidenced by the diminished and often barely palpable pulsation in the dorsalis artery.

Clinical findings. The blood supply here again claims our attention. In a series of non-union cases of the tibia it was noted that the foot on the affected limb was often cooler than the other. Frequently the dorsalis pedis pulsation was noted to be weaker. In this series of 11 cases of delayed or non-union, some cases operated upon and some not operated upon, blood pressure readings were made. With the patient in bed and both elowr limbs elevated 30 to 35 degrees the blood pressure taken in the injured leg below the site of the injury was invariably found to be lower than that of the other leg. This difference ranged from 5 to 15 millimeters mercury. With the limbs in the hanging position and the patient sitting up the difference was still present but to a less degree, ranging from 5 to 10 millimeters. These all were systolic readings taken by palpation. In two of the cases the pulsation could not be obtained in the dorsalis pedis artery so was taken in the posterior tibial.

X-ray findings. When the X-ray plates of these fractures are examined, a marked difference is at once noticed between the upper and the lower fragments. The lower fragment shows a more marked osteoporosis and absorption. It also shows less callus shadow.

Operative findings. On exposure of the fracture the X-ray findings are borne out. The lower fragment is softer, spongy, osteoporotic and shows less callus activity. There is very little if any filling in of the medullary canal. The sawn or curetted lower fragment produces less hæmorrhage than the upper. The blood simply oozes out whereas in the upper fragment, the nutrient or medullary artery often has to be crushed against the bone in order to obtain hæmostasis. In cases where plates and screws have been used, the screw holes in the lower fragments show little evidence of being filled in by bone, but on the other are often much larger, from absorption, than are the screw holes in the upper fragment.

In three cases the sawn sections from the two ends of the bones were examined in the laboratory with reference to the degree of bone formation. In all the cases there was less bone formation reported in the lower section.

Reports of microscopical examination from the University of Pennsylvania pathological laboratory are given below:

CASE NO. 6454. Fragments of tibia. A. Upper fragment. Portions of very dense tissue are seen and in a very dense matrix, composed of fibrous tissue and blood vessels are seen large numbers of cartilage cells, with here and there a small area of beginning calcification. There are some spicules of bone present which probably represent a pre-existing bone and not a new formation. The slide shows

active proliferation of the various elements necessary to bone formation.

B. Lower fragment. This slide contains portions of old cortical bone but the picture is one of disintegration rather than proliferation. There is an attempt to form new bone in one or two areas only.

CASE NO. 6570. A. Upper fragment. The slide shows cortical bone which is very dense and apparently unchanged in other respects.

B. Lower fragment. This slide shows some areas of tissue resembling cancellous bone. There is no evidence of bone proliferation. Some of the tissue has undergone a degenerative process, the bony structure being recognized with difficulty.

Experimental findings. Seeking to prove or disprove the effects of injury to the anterior tibial artery on fractures of the tibia a series of 12 dogs were operated upon. In all 12 the hind leg was fractured in the lower third. In four controls nothing further was done except fixation with plaster-of-Paris dressing reaching from around the body, to and including the foot. It was found necessary to include the foot and toes in order to prevent the dog from walking with the limb. In 8 dogs, in addition to the fracture, the anterior tibial artery was doubly ligated and severed. In 4 of the ligation cases the nerve was also cut. In none was there any especial attempt to get perfect reduction of the fracture. At the end of 4 weeks all the dogs were killed and the bone specimen removed and examined grossly and with the X-ray. In the four controls the union was solid and the callus formation apparently uniform. In the 8 ligation cases there was union, but in 5 of these the union was not as firm as in the controls. The cutting of the nerve seemed to have no effect upon results. The X-ray showed no demonstrable difference in the callus between the controls and the ligated cases.

CONCLUSIONS

The above evidence points to the fact that there is a lessening of the blood supplied to the lower fragment in these cases, which condition is associated with lessened bone reparative activity. The anatomy of the part leads us to turn our attention to the anterior tibial artery for the explanation. The fact that in the elevated position the blood-pressure difference between the affected and the normal limb is greatest should warn us to lower these fractures at the very earliest moment. Furthermore, the exposed and vulnerable situation of the artery to this the most frequent fracture site of the tibia should be a warning to us to be careful not to inflict traumatism in our reductions.

KRAUROSIS VULVÆ AND INGUINAL ADENITIS OF A MALIGNANT NATURE[1]

By FRANCIS REDER, M.D., F.A.C.S., St. Louis

THE two cases of kraurosis coming under my observation present the singular interest that in both instances a malignant degeneration was demonstrable. The one case exhibited a malignancy of the left labium with involvement of the left inguinal glands, the other case presented a malignancy in the region of the fossa navicularis encroaching upon both the right and left labium and involving the glands of the right and the left inguinal region.

Both women were married, had passed their menopause without ever having been pregnant and were respectively 51 and 54 years of age. The general health had always been good and only in latter years did the bodily weight take on an appreciable increase.

Itching of the vulva and a leucorrhœa had existed for about 4 years. The itching was of an intermittent character, at times mild and then again almost intolerable. The leucorrhœa also showed periods of variability, these being characterized by an almost complete cessation or a marked profuseness. It was noticed that whenever the leucorrhœal flow was slight the itching and burning about the vulva was much diminished. A severe attack of itching usually presaged a copious discharge. These patients felt more comfortable with a leucorrhœa of moderate severity.

In this condition Mrs. F. drifted along for 2½ years when she was compelled to consult a physician on account of great pain caused by coitus. An ulcer was discovered by her physician which was treated with "most everything" including roentgen-ray therapy. The condition grew worse, the ulcer growing to the size of a 25 cent piece in about 4 months. Excision of the ulcer was then undertaken. Nine months later the patient noticed a lump in her left inguinal region. This mass gave evidence of rapid growth. It was on account of the inguinal condition that my advice was asked.

The second case, Mrs. S. sought medical advice only after severe pain made coitus impossible. An examination disclosed conditions about the vulva which were interpreted by the physician as changes that naturally followed the menopause. This patient was treated locally with lotions and ointment. An examination 4 months later showed a well developed ulcerative area in the region of the posterior commissure. This was cauterized and treated with X-ray radiation. Under this treatment the ulcerative area encroaching upon both the right and the left labium did not appear to enlarge, neither did it show any disposition to heal. About 6 months after the cauterization of the ulcer patient felt a pain in her left groin. Placing her hand upon the site of pain she felt a small tumor. At the same time she made an examination of her right groin and there also discovered a swelling. My advice was sought with reference to the inguinal enlargement.

The clinical picture of these two cases presented the evidence of the Breisky syndrome in its extreme characteristics, with the addition of a typical cancer degeneration.

In both a burning and smarting sensation was present. There was a malodorous discharge from the infiltrated cancerous ulcer. The ulcer was irregular in outline and presented itself as a dirty granulating sore. Its tendency was to spread along the mucous surface toward the vagina, then outward over the skin and the labium. The mucous surface had lost its normal characteristics. It appeared a dead-white, thickened, smooth, and dry. About the surface there were scattered four to six reddish and brownish spots, which when touched were very sensitive.

No glans clitoris nor any labia minora were present, these structures having become obliterated during the progress of the disease.

The ostium vaginæ was abnormally narrow and appeared as though it had become cicatricially stenosed. An attempt to introduce the index finger into the vagina caused bleeding and much pain. Atrophic changes seemed to have taken place in the labia majora, and the mons veneris. A partial alopecia was apparent.

In the case of Mrs. F. a tumor the size of a tangerine occupied the left inguinal region. The case of Mrs. S. presented a tumor the size of a hen's egg in the right and the left inguinal regions. Both women were able to be about and felt fairly well. In the analysis of these two cases it can be demonstrated that the course of the disease ere it terminated into the stage of cancer, a degeneration fortunately not often encountered, passed through three distinct pathological phases: pruritus, leucoplakic vulvitis and kraurosis.

A simple pruritus vulvæ which is usually present in an innocent way for many years, can undoubtedly be responsilbe for subsequent morbid changes involving the mucosa of the external genitals. Trauma to the

[1] Presented at the meeting of the Southern Surgical Association, Hot Springs, Virginia, December 14, 15, 16, 1920.

epithelium of the vulva inflicted upon the burning and itching areas for relief is the precipitating factor in producing a low grade infection of the underlying connective tissue. An exudation of plasma occurs, the result of tissue reaction. The continued infection followed by exudation and infiltration causes œdema and this is seen clinically as engorgement, softening, and lividity. Eventually the affected area looses its normal color, becoming pale and dry, assuming the appearance of parchment. The vulnerability of the impaired structures becomes great on the slightest provocation and an added traumatism, such as a fissure, may engender a more severe form of pruritis which might finally develop into a leucoplakic vulvitis.

It is reasonable to assume that not in every instance does a leucoplakic vulvitis follow a pruritus. The pruritic stage may merge into the condition of kraurosis without a leucoplakic lesion. In kraurosis, however, where a cancer degeneration has taken place, the presence of a leucoplakic vulvitis must be accepted, inasmuch as there is no tendency to a malignant degeneration in kraurosis. There is, however, a tendency to a primary cancer of the vulva in leucoplakia.

A leucoplakic vulvitis is a disease which occurs in women past the menopause and is due either to natural atrophy of the glands at the time of the normal menopause or else to their surgical removal.

The histological changes are located in the epidermis and consist primarily of an absorption of elastic tissue from the uppermost layers of the corium over a portion or all of the vulva internal to the hairy portion of the labia majora (Taussig). The absence of elastic tissue invites trauma with a resultant low grade infection of the underlying connective tissue. As the disease progresses the affected areas become covered with thickened epithelial plaques, whitish in color. These plaques may cover more or less fully the entire area diseased.

Kraurosis, the last of the trinity, is a chronic infection the result of repeated traumatism with low grade infection usually occurring in women after the menopause. The fact, however, must not be overlooked that in younger women factors favorable to its production are found in a postoperative menopause. The three lesions have much in common and it can reasonably be assumed that a kraurosis is the final chapter to the damage done to the tissues by the lesions which invariably precede it. The characteristic state in which the vulva has been transformed by these extreme pathological processes has suggested the name kraurosis. It is a word coined from the Greek "*κραῖρος*," meaning "dry."

In kraurosis the histological changes are situated in the dermis and usually present a general atrophic process involving the entire vulva, with marked contraction of the vaginal orifice.

Not infrequently the glans clitoris and the labia minora have disappeared and the ostium vaginæ has become narrowed to such an extent that an attempt to introduce the index finger, if at all possible, is causative of great pain. Some cases frequently show atrophy of the mons veneris with complete alopecia. A patient afflicted with this disease is often a great sufferer, and not only is coitus very painful, but the itching and burning is frequently unbearable.

The assumption that the pathological process of kraurosis vulvæ can be accepted as an inherent primary disease appears to me to be still strongly lacking in corroborative evidence.

A critical analysis of the clinical picture of pruritis and leucoplakic vulvitis discloses so many features in common with kraurosis that the inference could be made that kraurosis is an expression of a severe degree of these lesions, and that without pruritis and leucoplakic vulvitis there would be no kraurosis.

The term "kraurosis vulvæ" can, therefore, be conveniently accepted as a lesion secondary to the pathological processes excited by pruritus and leucoplakic vulvitis, depicting the clinical picture of the impaired vulvar tissues in their most distressing condition. A kraurosis vulvæ degenerating into malignancy is as rare as a kraurosis lesion itself. This is very fortunate inasmuch as vulvar carcinoma demands an extensive

operative measure, even though the relief afforded be of short duration.

The mortality in cancer of the external genitals is high because of the frequency with which the tributary glands are involved early in the disease.

Just why cancer should be of rare occurrence in a kraurosis vulva is difficult to explain. The necessary factors conducive to malignancy are present, and present for a long time; the irritation and the debilitating influences caused by prolonged suffering are plainly apparent and the law that carcinomata have a predilection for surfaces where a transition takes place from one variety of epithelium to another is fairly well applicable to this condition, yet carcinoma as a sequela to kraurosis is said to be infrequent. Nevertheless a patient afflicted with kraurosis should be safeguarded against any possible malignant changes, and the lesion subjected to a measure radical in its execution. This measure is an operative one and consists in the complete excision of the affected area.

In the earlier stages before the clinical picture becomes pronounced and an intense pruritis apparently is the only existing condition, the source of the irritation should be sought and if possible removed. An intense pruritus not amenable to treatment is a condition which justifies excision of the areas involved. When the lesion presents itself as a pronounced kraurosis and is associated with a leucoplakic vulvitis, an association not at all infrequent, we should appreciate the experience of others who have subjected these conditions to radium and roentgen-ray treatment. The results of these treatments have been most disappointing and in frequent instances have caused much suffering to the patient. In three instances Taussig used radium with only temporary improvement after a period of extremely painful radium reaction. In the hands of the same observer, roentgen-ray and radium treatment in cancer of the vulva have given most unsatisfactory results.

Some investigators recommend in a pronounced condition of kraurosis with dyspareunia an incision widening the vaginal outlet. I would advise against this procedure as it has little to recommend. It has no beneficial influences upon the condition, and does not prevent a subsequent contraction of the ostium.

Reverting to the two cases with infiltrated cancerous ulcers and metastases in the inguinal glands, a radical excision was made in each instance. The operation pertaining to the inguinal dissection requires a technique of much delicacy and is somewhat severe. An operation of this character cannot be a satisfactory one unless all inguinal glands are removed, especially important ones situated deeply around the femoral vessels. Such a dissection requires the division of Poupart's ligament.

The relief these patients obtained was most gratifying. Up to date they are free from any of their former suffering, with no evidence of any recurrence.

The operations were performed respectively 9 and 11 months ago, a time allowance too brief in the consideration of recidivation.

BILHARZIASIS

By ROBERT V. DAY, M.D., Los Angeles

THE rarity of bilharziasis in the United States prompts me to report the following case:

Mr. C. F. B., age 24, medical student, born and reared until the age of twenty in the Transvaal, British South Africa, has been having slight hæmaturia much of the time for 2 or 3 years. He was seen first June 5, 1920. The symptoms described by him were: (1) occlusion of urethral orifice by unknown cause during urination; (2) hæmaturia.

He had been having hæmaturia for the 3 weeks just preceding and had been unable to void for 24 hours. A catheter had been used obtaining bloody urine with difficulty because of clots obstructing the catheter lumen. A great mass of clots was evacuated with the evacuating pump of Ware. Cystoscopy then disclosed a considerable mass of clots left in the bladder but not enough to interfere with cystoscopy. A typical benign-looking papilloma near the left ureteral orifice was seen and fulgurated thoroughly. Microscopical examination of the urine by Dr. Herschel Butka, pathologist to the White Memorial Hospital, disclosed typical ova of the distoma hæmatobium with characteristic terminal spines. These were present at all examinations of the urine up to and shortly after beginning of specific intravenous treatment of tartar emetic.

On July 7 cystoscopy was done and the base of the papilloma was fulgurated. There were present over the trigone, principaly over the left side, and on the bladder neck, small miliary papules reddish white in color. The ureters were catheterized at this time to obtain eggs direct in case left kidney was infected. No eggs were found, however.

Cystoscopy was repeated on August 26. Hundreds of these miliary papules were present in practically every portion of the bladder wall. This alarmed me and the question of intravenous injections of tartar emetic was advised after the question had been taken up with Dr. Stitt of the Tropical School of Medicine. He was treated under the supervision of Dr. Newton Evans, president of the College of Medical Evangelists. I can hardly improve upon the patient's own report which is as follows:

"*General measures in treatment.* 1. Physical exertion reduced to a minimum.

"2. Breakfast is light on mornings of injections.

"3. After injection 2 hours of absolute rest.

"4. Mental work reduced to minimum yet sufficient to 'get by.'

"5. Sleep encouraged by warm bath before retiring and bed time at least 9 hours.

"6. Regularity at meals.

"7. Keep bowels active."

Note. In the urine there always had been a certain amount of pus but as the doses increased this decreased until with the reds it vanished.

The color of this urine was always normal but at first rather cloudy. This cloudiness, however, subsided as the albumin and reds decreased.

There always was a slight cystic and urethral irritation showing itself in a sense of tension, but not associated with pain. This had disappeared after having taken 7¼ grs. of tartar emetic. (See Table.)

DISCUSSION

"Certain symptoms were continuous throughout the whole course of treatment: These were, bronchial irritation, pleural pain, backache, mental depression, conjunctivitis, vertigo, and muscular weakness. After each injection they became worse within 30 minutes from time of administration and continued 24 to 26 hours afterward.

"There was a week omitted between November 19 and 27 when the administration was suspended on account of the accumulative poisoning symptoms becoming very marked. The treatment lasted a month and 5 days and the total amount of tartar emetic was 15 grains.

"During the whole time sleep and appetite were fair, except the last two administrations caused a loss of appetite. The bowels moved sluggishly and, therefore, cathartics were frequently resorted to. Every evening a hot spray was taken to promote sleep and restfulness during the night.

"Each day one-half grain of dessicated thyroid (P. & D.) was taken to stimulate metabolism and thereby increase mental activity, thus counteracting the depression of the drug. It was found necessary to take an increased mental stimulant with each final examination, consequently 10 grains of caffeine citrate were taken in divided doses 4 and 2 hours respectively before each of three final examinations that came during the period of administration. The results were excellent.

"During the whole time the patient was about and doing all work that had to be done and no more.

"The symptoms that lasted the longest were pleural pain, pain in the region of the left kidney, and conjunctivitis. Two weeks after the last dose a series of Russian baths alleviated these symptoms so that it might be considered that the crisis was over and improvement was slow but sure. Muscular weakness was still pronounced and general depression also. It was found that after any physical exertion there ensued great pleural pain and extreme fatigue. During the administration the erythrocyte count was reduced one-half million, becoming 5,000,000; the leucocytes increased from 6,500 to

RÉSUMÉ OF COURSE IN CASE OF C. F. B.

Date	Dose	Ova	Albumin	Symptoms
10/28/20	¼ gr.	Ova hatch after 5 minutes in water. Many present.	1.5 per cent. Slight hæmaturia.	None.
11/1/20	½ gr.	Ova hatch after 5 minutes in water. Many present.	1.5 per cent. Slight hæmaturia.	None.
11/2/20		Ova hatch after 3 hours in water.	1.5 per cent. Slight hæmaturia.	None.
11/3/20		Ova hatch after 3 hours in water.	1.5 per cent. Slight hæmaturia.	None.
11/4/20		Ova hatch after 3 hours in water.	1.5 per cent. Slight hæmaturia.	None.
11/5/20	1 gr.	Ova hatch after 3 hours in water.	1.5 per cent. Slight hæmaturia.	Mental depression and oblivion.
11/6/20		Ova hatch after 3 hours in water.	Hæmaturia less. Albumin less than 1 per cent.	Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys.
11/7/20		Ova hatch between 24 and 30 hours incubation.	Hæmaturia less. Albumin less than 1 per cent.	Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys.
11/8/20	1½ gr.	Ova hatch between 24 and 30 hours incubation.	Hæmaturia less. Albumin less than 1 per cent.	Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys.
11/9/20		Ova present. Blue blotches in center.	Albumin—mere trace. Very small hæmaturia, few reds.	Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. And increased.
11/10/20		Ova present. Blue blotches in center.	Albumin—mere trace. Very small hæmaturia, few reds.	Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. And increased.
11/11/20		Ova present. Blue blotches in center. Ova decrease in number.	Reds less. No albumin.	Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. And increased.
11/12/20	2 gr.	Ova decrease in number.	Reds less. No albumin.	Symptoms same.
11/13/20		Ova do not hatch after 48 hours incubation.	Reds less. No albumin.	Symptoms same.
11/14/20		Less ova.	Reds less. No albumin.	Symptoms same.
11/15/20	2 gr. Codein ¼ gr.	Less ova.	Reds decrease. No albumin.	Lethargy, muscular weakness, headache, cough and pain in back.
11/16/20		Less ova.	Reds decrease. No albumin.	Lethargy, muscular weakness, headache, cough and pain in back.
11/17/20	1½ gr. Aspirin 20 gr.	Less ova.	Reds decrease. No albumin.	Same as above. Aspirin allayed immediate symptoms such as depression sense of fatigue and headache.
11/18/20		Less ova.	Reds decrease. No albumin.	Same as above. Chronic conjunctivitis starts.
11/19/20	1½ gr. Aspirin 20 gr.	No ova.	No albumin. No blood.	Symptoms intensified. Conjunctiviti in right eye.
11/20/20	1½ gr.	No ova.	No albumin. No blood.	Symptoms intensified. Conjunctivitis in right eye.
11/21/20		No ova.	No albumin. No blood.	Symptoms intensified. Conjunctivitis in right eye.
11/22/20		No ova.	No albumin. No blood.	Symptoms of S——— B——— poisoning, prominent tightness in chest. coughing, headache, severe backache. muscular weakness, general depressions puffing of evelids and conjunctivitis.

Date	Dose	Ova	Albumin	Symptoms
11/23/20		No ova.	No albumin. No blood.	Symptoms of S——— B——— poisoning, prominent tightness in chest, coughing, headache, severe backache, muscular weakness, general depression, puffing of eyelids and conjunctivitis.
11/24/20		No ova.	No albumin. No blood.	Better — no headache.
11/25/20		No ova.	No albumin. No blood.	Better — Lots better.
11/26/20		No ova.	No albumin. No blood.	Better — Lots better.
11/27/20		No ova.	No albumin. No blood.	Better — Lots better.
11/28/20	1½ gr. Aspirin 20 gr.	No ova.	No albumin. No blood.	Weakness, dizziness, apathy, severe conjunctivitis, pain in pleura and left kidney. Bronchial irritation.
11/29/20		No ova.	No albumin. No blood.	Weakness, dizziness, apathy, severe conjunctivitis, pain in pleura and left kidney. Bronchial irritation.
11/30/20		No ova.	No albumin. No blood.	Weakness, dizziness, apathy, severe conjunctivitis, pain in pleura and left kidney. Bronchial irritation.
12/1/20	1½ gr. Aspirin 10 gr.	No ova.	No albumin. No blood.	Symptoms same, and severe diuresis, loss of appetite.
12/2/20	1¾ gr. No aspirin.	No ova.	No albumin. No blood.	Symptoms same, and severe diuresis, loss of appetite.

13,500 and the hæmaglobin remained normal, 95 per cent.

"During the course of treatment the temperature remained normal the whole time.

"In body weight there was a slight decrease amounting to 8 pounds."

Cystoscopy on October 1 revealed a nearly normal bladder with some œdema and lack of clear cut vascularity.

Cystoscopy on January 7, 1921, showed a normal bladder with just the slightest appearance of telangiectasis to the right of the right ureteral meatus. The urine was negative for red blood cells and ova and had been for many preceding examinations.

From the above report we feel quite sure the patient has been cured.

The experience of the British and American Tropical Schools for Medicine has been apparently little short of marvelous with the above treatment. Dr. Charles S. Vivian of Phoenix, Arizona, recently told me, however, of a case under his care uncured that had been treated with intravenous tartar emetic injections by the British Army authorities. A few deaths have been reported from the larger doses.

A LARGE MYCOTIC EMBOLIC ARTERIOVENOUS ANEURISM OF THE FEMORAL VESSELS

By ROLFE FLOYD, M.D., New York

THIS case is reported because of the large size of the sac, its large venous connection, the fact that, without rupture, it caused initial and pronounced symptoms before the underlying viridans endocarditis was evident, and finally because there was septic endarteritis with a thrombus in the opposite femoral artery establishing the mycotic embolic origin of the aneurism.

The historical steps in the recognition of mycotic embolic aneurisms are somewhat as follows:

First, embolic abscesses of artery walls were recognized in 1844 by Rokitansky (1). Then in 1853 Tufnell (2) definitely recognized the dependence of an aneurism on emboli derived from vegetations on the heart valves.

Twenty years later Ponfick (3) in 1873, published 7 cases and expressed new views about the pathogenesis of the condition. He recognized that the causative endocarditis was regularly acute, usually an acute engrafted on a chronic process, that the aneurisms were usually small, multiple, and frequently found in cerebral or abdominal vessels, that they belonged to adolescence and early adult life and occurred in arteries otherwise normal. He further believed that the damage to the artery wall began on the side next the lumen and worked out, and that thus the intima, elastica, and media were usually broken through and the sac wall was composed of adventitia and new formed layers, either organized thrombus inside or inflammatory tissue outside. He also observed that these lesions usually developed at or just central to points where the arteries divide. All these observations and conclusions have been confirmed by the work of later students on the subject.

Ponfick also believed that the loose areolar tissue of pia and peritoneum offered no accessory support to a weakened arterial wall and so negatively favored its distention, a factor which seems real but not entirely determinant, for these lesions also occur in the comparatively dense tissues of the extremities.

By a peculiar freak of circumstance in one of his first cases, he found a sharp calcified embolus that had pierced the entire artery wall, a lesion apparently of the utmost rarity. This experience led him to consider the production of all embolic aneurism to be mechanical; he searched assiduously for a minute particle of lime in every case, and when he could not find one he believed the erosion of the vessel wall to be due to mechanical pressure of the embolus against the wall, made more effective by the pulsating pressure of the blood stream, a "decubital necrosis" analogous to bedsore formation. He accordingly denied the primary chemical action and infectious nature of cardiac emboli though fully appreciating these qualities in emboli derived from infectious venous thrombi. This mechanical pathogenesis has not been generally accepted although two cases similar to Ponfick's unquestionable one were reported by Thoma (4) in 1889.

In 1887, fourteen years later, Eppinger (5) made an exhaustive study of the subject and, except in one point, his views, added to the accepted ones of Ponfick, form the basis of the present conception of the condition.

In the first place he showed that the same bacteria were present in the fresh cardiac vegetations and in the emboli, and concluded, in contrast to Ponfick's mechanical theory, that the damage to the artery wall was due to inflammatory and destructive changes induced by these bacteria. He accordingly introduced the term *mycotische embolishe*.

He especially emphasized the rupture of intima and elastica, demonstrated their

torn edges at the sac mouth and considered the rupture of the elastica as a constant feature and a prerequisite in the pathogenesis of the lesion. The media he found usually ruptured but sometimes partly preserved in the sac wall, and the adventitia its only constant component. In recent cases he found the infectious embolus and active septic inflammation of the vessel wall, but in cases of longer standing, where these features were no longer demonstrable, he considered the ruptured edge of the elastica at the sac margin diagnostic and multiplicity of the lesion an added confirmation.

He, however, held a peculiar notion about the way the lesion developed in the vessel wall, namely, that the first step was the development of a septic peri-arteritis in the tissue just outside the vessel opposite the site of lodgment of the embolus, the second step a septic mesarteritis which finally burst into the lumen, like an abscess, first undermining and then rupturing the elastica and intima in the process.

This view has not found general acceptance and its opponents believe that Eppinger was led astray, just as Ponfick was, by encountering a very rare condition in one of his cases, namely a septic embolus of one of the vasa vasorum, and interpreting his other cases on this basis.

Those who oppose Eppinger's view hold that the inflammation begins in the artery wall where the thrombus lies in contact with it and progresses from the lumen outward.

Unger (6), in 1911, wrote an excellent and convincing paper with careful microscopic studies establishing the correctness of this conception. In one of his cases with septic endocarditis there was no aneurism but an ulcerative lesion in the femoral artery just where the profunda comes off, septic inflammation of the vessel wall, local destruction of the intima, elastica, and part of the media, and a septic thrombus adherent to the ulcer partly occluding the lumen of the vessel. This is almost exactly the lesion which the case I report showed in the left femoral artery.

Aneurisms can occur with acute endocarditis in another way. Vegetations may form on the aortic wall, especially in the ascending aorta, just as they form on the valves or on the mural endocardium and the vessel wall beneath them may be ulcerated, weakened, and may pouch into sacculated aneurisms which are mycotic but not embolic. Such are reported by Osler (7), 1885, and McCrae (8), 1905.

Lewis and Schrager (9), 1909, in an excellent review of the subject preliminary to reporting their own cases state that "the case reported by Osler in which one of the aneurisms was as large as a billiard ball is probably the largest embolomycotic aneurism observed." Unger, 1911, however, reports one of the left femoral artery 11 by 10 by 7 centimeters, the largest of which I have been able to find a previous record. The one I am about to describe measured 15 centimeters in length and over 6 centimeters in diameter.

Unger, reviewing the reported cases in 1911, found 91 mycotic-embolic aneurisms of which 8, or nearly 9 per cent, were femoral and situated at the point where the profunda femoris comes off.

Arteriovenous aneurism, on the other hand, appears in the literature as a comparative rarity up until the onset of the late war in 1914, since which many have been reported. Practically all such cases are regarded as due to the simultaneous penetration of an artery and vein where they lie close together by a weapon or projectile. I have, however, found only two cases of embolic-mycotic arteriovenous aneurism described; one by Simmonds (10), 1904, the second by Libman (11), 1907.

Simmonds' was a sacculated aneurism the size of a hen's egg at the aortic bifurcation, which secondarily perforated the right common iliac vein by a hole the size of a lead pencil. It occurred in a woman 31 years old dying of puerperal sepsis without giving pronounced symptoms of the aneurism.

Libman's case was in a man, 25 years old, sick of infectious endocarditis who suffered with pain in the groin for 4 weeks and then developed an elastic swelling in

the left femoral region, painful and tender with expansile pulsation and a loud systolic-diastolic humming murmur with a systolic accentuation. The "left femoral artery showed quite marked endarteritic changes. There was an aneurism at the point where the profunda was given off. The sac contained thrombatic masses, most of which were not at all decolorized. The remains of the vessel wall were present in the sac. The femoral vein had a small deficit in its wall externally and anteriorly which led into the sac." Staphylococcus aureus was found in the sac and streptococcus and staphylococcus aureus in the heart blood. The ordinary aneurism of later life, usually developed in syphilitic vessels, may, however, perforate into a vein, and so produce an arteriovenous aneurism. Such a case came under my care on the 2d Medical Division at Bellevue Hospital in January, 1916. A man with an enormous sacculated aneurism of the ascending aorta was profoundly cyanotic for 2 weeks before death and at autopsy there was found a slit-like opening about 1 inch long from the superior vena cava into the sac.

Following is the record of the case which it is the purpose of this paper to report:

Carpenter, age 36; admitted to Roosevelt Hospital, July 31, 1919, complaining of rheumatism. Five of his brothers have rheumatism, but he had never had it before. He himself had measles, diphtheria, mumps, whooping cough, and frequent sore throat, as a boy. He is subject to attacks of indigestion and vomiting. He has had a right hydrocele for 7 years which has been repeatedly tapped. Otherwise his health has been good. No cardiac or renal symptoms. There is no history of any injury or wound in the right leg or groin. Ten weeks ago he noticed his right ankle was swollen but not painful. A little later he began to have pain all through the leg which was worse when the leg was kept quiet and was relieved by massage. Both the swelling and pain have increased up to the time of admission.

Examination. Color and nutrition about normal but he has the face of pain. No pharyngitis; pupils react normally. Lungs are normal. Heart is slightly enlarged, action regular but a little too strong, 100; soft systolic murmur at the apex, transmitted to the axilla. Abdomen is normal; neither the liver nor the spleen is enlarged. There is marked pitting œdema of the whole right leg and right side of the scrotum. There is no evidence of inflammation of the knee or ankle but motion, especiallly extension, of the hip causes much pain. There is a large hard pulsating tumor just below Poupart's ligament over which a distinct systolic thrill is felt, and a systolic and diastolic murmur heard. The tumor is quite tender on pressure. No tumor or pulsation is felt above Poupart's ligament but there is tenderness in this region. There is no œdema elsewhere. Rectal examination is negative. Urine on repeated examinations regularly showed a trace of albumin, never any sugar, rarely a few casts. X-ray showed nothing abnormal in the chest or in the right hip-joint. Blood cultures at first were sterile but at the end of 2 weeks showed streptococcus viridans, a finding which was confirmed by subsequent examinations. Wassermann test on the blood was negative. Blood examinations made on admission and later resulted as follows:

Hæmoglobin Per cent	White Cells	Polymorphonuclears Per cent
60	11,800	70
80	8,600	72
85	7,600	68

He ran an ordinary septic temperature, usually between 99.5° and 102.5° and never reaching 104°. The pulse was rapid in proportion to the temperature, almost always over 100 and averaging about 110. The respiration ran between 20 and 24.

Although I made the diagnosis of aneurism, probably arteriovenous, on admission, much doubt about the case developed later because it hurt him too much to extend the thigh, and in semi-flexion, and with the general œdema and local inflammation about the sac, it was hard to be clear about the nature of the tumor and much of the time impossible to get any pulsation in it. Added to this came the fact that the diastolic murmur was absent most of the time and the systolic a good part of it. As a result the diagnosis of septic thrombosis of the external iliac vein had more advocates than aneurism when he died on October 21, 11 weeks after coming to the hospital, and 5 months after the appearance of his initial symptoms of swelling of the right leg. The cardiac condition had meantime become increasingly evident not only from the cultures but from cardiac symptoms and conjunctival and cutaneous petechiæ as well.

The autopsy which I performed about 18 hours after death showed: acute endocarditis of mitral and aortic valves; arteriovenous aneurism of right femoral vessels; septic arteritis of left femoral artery; acute exudative nephritis with tubal hæmorrhages, and infarcts; enlarged spleen with infarcts; petechial hæmorrhages of skin and conjunctivæ; œdema and congestion of lungs; double hydrothorax; general subcutaneous œdema especially marked in lower trunk and legs, massive in the right leg; old hydrocele.

The heart showed distinct but not extreme enlargement of the cavities of both ventricles with decided thickening of their walls. Valves of the right side were normal. Mitral valve had huge vegetations of yellow fibrin with recent bloody deposits on both cusps, and there was considerable ulceration with loss of substance of the cusp edges. The aortic valve had a fibrin vegetation 3 millimeters in diameter and 1 centimeter long on one flap which was inflamed and penetrated at the point of attachment of the vegetation; another aortic cusp bore a small recent vegetation, while the third was normal. There was a small mural vegetation on the ventricular endocardium well below the mitral orifice. The muscle wall of the left ventricle was extensively studded with whitish areas which looked like patches of fibrous tissue. Coronary vessels were normal. The pericardium was normal. Under the microscope the heart muscle showed areas of degenerated or absent muscle with a growth of fibrous tissue; pus and round cells infiltrated these areas very irregularly, sometimes practically absent, sometimes quite copious and collected into small foci, but never constituting true abscesses. In two instances a plug of fibrin and pus cells were to be seen inside small vessels penetrating areas of muscle degeneration; in one case the vessel wall was indistinct and evidently damaged. Thus the areas of degeneration seemed to be embolic and the effects of the emboli both mechanical and septic.

The aorta showed only some insignificant patches of ordinary sclerosis.

The kidneys were rather large, with several yellow cortical infarcts; capsules were not adherent; the color a light buff sprinkled with red pin points; cortex of normal relative thickness but its markings obscure; medulla dark red in sharp contrast. Under the microscope small groups of tubes were filled with blood causing the red spots seen in the cortex. The epithelium of the convoluted tubes was mostly somewhat flattened and the tubular lumina enlarged, but there was no exudate in them except for a very moderate amount of coagulated matter, hardly more than normally seen. The glomeruli showed a general but slight increase of the tuft cells obscuring the outlines of the individual capillary loops to some extent. The straight tubes of the medulla were many of them full of blood which accounts in large part for its red color. The capillaries both of cortex and medulla were comparatively empty. The connective-tissue stroma was not increased. Some of the smaller arteries were slightly thickened.

There was a large sacculated aneurism springing from the posterior surface of the right femoral artery in Scarpa's triangle, by an orifice elongated in the axis of the vessel, 2.5 centimeters long and about 0.7 centimeters wide, with smooth edges. The femoral vein lay on the front wall of the sac and there was an opening from the vein into the sac, also elongated in the axis of the vessel, 5 centimeters long. Its edges also were mostly smooth. Thus the openings from artery and vein into the sac lay parallel and side by side, the venous opening having the greater vertical extent. The sac was 15 centimeters long and over 6 centimeters in diameter. It extended up behind Poupart's ligament into the iliac fossa and the ilium was so deeply eroded beneath it that the acetabulum was opened and the head of the femur lay against the sac. The femur, however, showed no erosion. The sac contained clotted blood but no extensive laminated mural clot. There was a good deal of inflammatory tissue, apparently mostly new connective tissue, about the sac so that its dissection was somewhat difficult. There was no appearance of hæmorrhage with false sac wall formation or anything to suggest a dissecting aneurism. The femoral artery showed some sclerosis of the Moenckeberg type with annular depressions of its wall. Unfamiliar with the literature, I failed to look for the torn ends of the intima and elastica at the margins of the sac mouth.

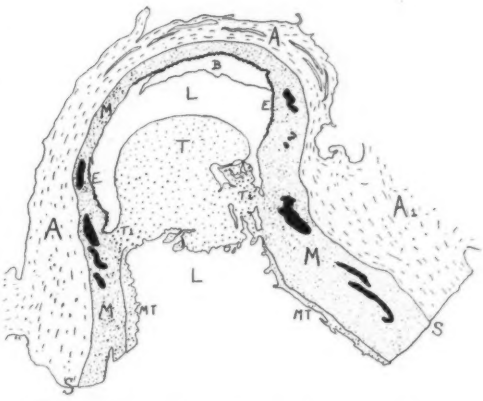

Fig 1. Diagrammatic camera lucida sketch X 30 of a section across the lesion in the left femoral. The artery was split open and the edges of the split, *s* and *s*, spread wide apart in the hardening fluid. *L*, Lumen. There is no intima. The heavy undulating lines, *e* and *e*, represent all that is still traceable of the elastica. The media, *m*, *m*, is thickened by connective-tissue growth and by round-cell infiltration. The solid patches in it are the foci of calcification of Moenckeberg's sclerosis. In places it lies naked to the blood current in the lumen, in places it is covered by elastica, in places it is overlain by thrombi, *mt*. The adventitia *a*, *a*, is normal. At A^1 it goes over into the sheath and adventitia of the femoral vein.

The large thrombus, *t*, is quite fibrous at its attachment T^1, soft, shaggy, and infiltrated with pus, and round cells are its opposite attachment T^2.

The mural thrombi, *m t*, *m t*, probably lay close to or were continuous with the lower edge of the central thrombus before the vessel was opened, the larger portion of lumen and the more normal vessel wall lying above it (in the drawing). Some blood, *b*, settled on the vessel wall postmortem.

In the left femoral artery just below Poupart's ligament there was an ulcerated area, soft and necrotic, about 3 centimeters long to which a large thrombus was adherent which partially occluded the vessel. This artery like its fellow also was the seat of Moenckeberg's sclerosis, a lesion which apparently had nothing to do with either the aneurism or the thrombosis. Under the microscope the artery wall was found infiltrated with round and pus cells; the intima was completely lost; the membrana elastica could be traced through part of the circumference. Deeper in the wall of the media could be seen the lime deposits of Moenckeberg's sclerosis. The thrombus was large and partly filled the lumen; it was attached to the artery wall in two places. Blood vessels penetrated it and fibroblasts were growing in it. On one part of it was a fresh deposit of fibrin and leucocytes. There were a number of phagocytes containing brown pigment in the artery wall and clot margins. A section stained with methyline blue showed no micro-organisms. (See Fig. 1.)

The unusual features of the case then are: (1) The large size of the sac, its wide venous connection, and the density of its wall, preventing its rupture and enabling it to erode bone. (2) The extensive lesion inside the opposite femoral with ulceration and formation of an organizing thrombus but without any aneurismal dilatation. These features appear to depend in part on an infecting organism of low but persistent virulence which allowed time for extensive connective-tissue growth and in fact may have stimulated it. This low virulence is evidenced by the long duration of the illness, the late appearance of cardiac symptoms, the character of the lesions in the muscle wall of the heart as well as of those in the right and left femoral arteries.

I have found some 55 references in the literature bearing on the subject, but only those referred to in the paper are given.

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GASTRO-ILEOSTOMY

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REPORTS of gastro-ileostomy performed when gastrojejunostomy had been intended are extremely rare. Only a few are on record. Mercur, after searching the literature up to 1917, cites 2 additional cases and reports 1 which came under his observation. In further search from 1917 to January, 1921, I fail to find any records of similar occurrences. The two other cases cited were described by Judd, of the Mayo Clinic (1912), and Carroll, of Baltimore (1915). A brief résumé of the aforesaid cases follows:

In Judd's and Mercur's patients the anastomosis between the stomach and ileum was 5 and 6 inches proximal to the ileocæcal junction; in Carroll's it was 20 inches. In all the cases the faulty condition lasted from 2 to 3 years before coming under the observation of the above authors. The confirmatory examination in each were the roentgen-rays. The following characteristic symptomatology was present in the three patients: burning sensation in the epigastrium, loss of weight, obstinate constipation, vomiting, nausea, loss of appetite, self-restricted diet, anæmia.

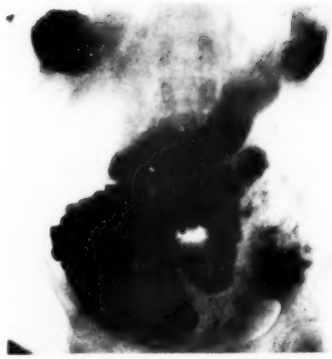

Fig. 1. Roentgenogram of patient standing, immediately after ingestion of barium meal.

In all of these cases the pylorus was found to be patent and normal at the time of the second operation. No evidence of any previous ulcers in the stomach or duodenum was discernable. Owing to this patency of the pylorus the patients were able to survive for 2 or 3 years after the operation inasmuch as some food passed into the small intestine and was digested and absorbed. This patency was demonstrated in all the cases by the roentgenogram. The amount of food which passed through the pylorus, however, was very small, being practically just enough to prevent starvation.

Judd's patient died, probably of acidosis as no apparent pathological reason for death cou'd be discovered at autopsy. Mercur's recovered, convalescence being interrupted by a postoperative ileus which responded to treatment. Carroll's patient recovered without any operative complication.

Mrs. L. W., age 40, Russian, consulted me on February 4, 1919. Her family and personal history were negative. About 4 years ago she developed sharp cramp-like pain in the right upper quadrant of the abdomen. This was constantly present and was neither relieved nor aggravated by the intake of food. The local applications of heat to the abdomen were the ony measure which afforded some relief. The pains increased progressively in severity. There was no vomiting and no hæmatemesis but nausea was a constant manifestation. There was also considerable belching of gas and an occasional feeling of distress in the epigastrium. Jaundice was never noted. These symptoms lasted 2 years during which time she lost about 25 pounds.

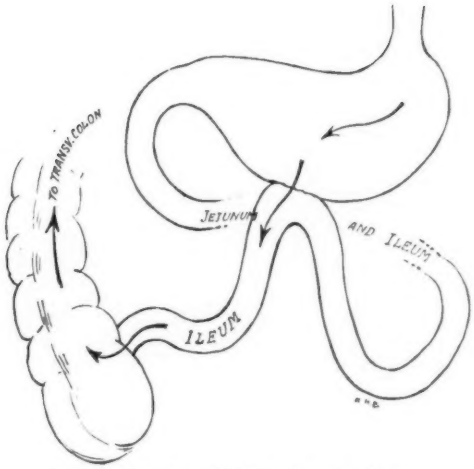

Fig. 2. Drawing of findings in author's case.

In March, 1917, she was operated upon and a gastro-enterostomy performed. She was told that she had had an ulcer of the stomach. She left the hospital in 3 weeks. The previously described symptoms, however, soon returned. There was no relie whatsoever. In addition there was irritability and insomnia. These symptoms continued for 2 years during which time she continued to lose in weight, losing 25 pounds more. Her weight at this time was 85 pounds. During these 2 years she made the rounds of physicians, hospitals, and clinics, everywhere being proclaimed "a neurasthenic." About this time she came under my observation. After considering her symptomatology, a serial roentgenographic study of her gastro-intestinal tract was ordered, and Dr. David J. Hyman, who made the examination, sent me the following unusually interesting report:

"Immediately after the ingestion of a contrast meal, stoma of a gastro-enterostomy was observed, evacuating large amounts of meal which quickly advanced through the terminal coils of the ileum in a diagonal direction to the right, to the region of the cæcum in almost a straight line, about 7 or 8 inches long. A few minutes later the cæcum and ascending colon were entirely visualized. At the end of one-half hour or even less, the colon was visualized up to the splenic flexure and the stoma was four-fifths empty of opaque meal. No food was observed evacuating from the duodenum.

"Plate 1, erect position, shows the stomach rapidly emptying. There is a coil of terminal ileum extending from the stoma to the ileocæcal valve which is constantly full of barium meal, quickly delivering it into the cæcum and colon. The head of the barium column, at this time (10 or 15 minutes after the ingestion of the meal) is two-thirds across the transverse colon, nearly to the splenic flexure.

There is a moderate amount of contrast meal in the jejunum and proximal ileum showing that the pyloric sphincter is patent.

"Plate 2, erect position, and Plates 3 and 4, prone position, show the same condition as Plate 1.

"Fluoroscopic examination, one and one-half hours after the barium meal, shows a moderate amount of barium meal still in the stomach. Head of the barium is near the splenic flexure.

"Plate 5, one and one-half hours after the barium meal, shows the head of barium meal well up near the splenic flexure. The residue observed on fluoroscopy at this time is not shown in the plate on account of the plate being focused too low. The coils of the proximal ileum contain a small amount of barium meal. Fluoroscopic examination, 7 hours after the meal, shows no residue in the stomach, the whole contrast meal, being practically in the cæcum, ascending colon, and transverse colon. There is a small amount of meal in the coils of the proximal and distal ileum which no doubt was evacuated through the pylorus.

"Plate 6, 7 hours after the barium meal, shows this same condition. Fluoroscopic examination at the end of 24 hours shows small remnants of the meal in the proximal transverse colon, none in the descending colon; sigmoid colon and rectum are full of meal.

"Plate 7 shows this condition recorded on the plate. Conclusions: four-fifths of the meal or more is quickly evacuated into the cæcum and transverse colon, practically no digestion taking place; one-sixth of the meal, probably, or less, passes through pylorus and is properly digested."

On February 17, 1919, she was admitted to the People's Hospital where the routine clinical examinations confirmed those already made. Physical examination showed her poorly nourished and emaciated (weight 80 pounds). Her abdomen, except for a high median scar, the result of her former operation, presented nothing pathological.

Operation — laparotomy. A median incision was made from the ensiform down to the level of the umbilicus, excising the old scar. On opening the peritoneum, adhesions were found uniting the pylorus and gastrohepatic omentum to the surrounding viscera especially to the liver, gall-bladder, abdominal wall, and to the small intestine. The adhesions were gently separated from the neighboring structures. Exploration of the stomach and duodenum presented no evidence of recent or healed ulcer. The pylorus was patent and admitted the index finger. The gall-bladder, except for being bound down by adhesions, showed no stones or evidence of disease. The previous gastro-enterostomy was found and consisted of a union between the stomach and the ileum, 8 inches proximal to the cæcum. The entire colon and the sigmoid were very much distended. The appendix had been removed at the first operation.

The ileum was cut away from the stomach, and the part of the ileum containing the stoma was resected and an end-to-end anastomosis (McGrath method) was made. This completed the continuity in the ileum. The next problem was the disposition of the stoma in the stomach. Two solutions presented themselves: (1) the closure of the stoma with the restoration of the intestinal canal to normal continuity or (2) performing a gastrojejunostomy. I decided on the latter course because of the large amount of adhesions present about the pylorus, which, although they had been separated, would surely re-form. Consequently the ligament of Treitz was located and the jejunum, about 5 inches away, was brought up to the stoma in the stomach and a posterior gastrojejunostomy performed. The abdominal wall was then closed. Convalescence was interrupted the first 3 days by the development of a postoperative ileus which, however, soon responded to treatment. Several days before being discharged, I excised some very large internal and external hæmorrhoids by the ligature method, using local anæsthesia of quinine and urea hydrochloride and novocaine.

At the time of this report, just one year later, the patient steadily gains in health. Her weight now is 130 pounds, an increase of 50 since the operation. There are no "neurasthenic" symptoms, and she is cheerful and happy. There are no pains in the epigastrium, no nausea, vomiting, and no belching. Her bowels move daily without catharsis. Her appetite is good and her diet is unrestricted.

SUMMARY

1. These cases are fortunately very rare.

2. The ligament of Treitz is a fixed point high up in the left hypochondrium and should be readily recognized in contradistinction to the ileum which is close to the cæcum, the latter being easily recognizable.

3. Some of the food in my patient passed through the pylorus and small intestines thus allowing just enough nourishment to prevent the patient succumbing from starvation.

4. This patient's symptoms were diagnosed as neurasthenic for 2 years.

5. The same symptoms were present in all the cases reported, viz.: obstinate constipation, burning sensation in epigastrium, loss in weight, and nausea.

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DEPARTMENT OF TECHNIQUE

THE RUBIN TEST SIMPLIFIED

By H. DAWSON FURNISS, M.D., F.A.C.S., New York

DR. RUBIN has achieved a notable advance in our diagnostic methods, by demonstrating the patency or non-patency of the fallopian tubes by injection through them of carbon dioxide by way of the uterine canal.

In his routine work he injects from 150 to 200 cubic centimeters of carbon dioxide, and demonstrates its presence in the abdomen by fluoroscopy. In the erect posture the gas is shown as a white line between the diaphragm and the liver or the diaphragm and the spleen. This amount of gas causes a characteristic pain in the shoulder that persists from a few minutes to an hour or more.

His method has been in use on my service at the Post-Graduate Hospital for 2 months. Every case of sterility is so tested, and none is to have any form of operation for sterility until so examined.

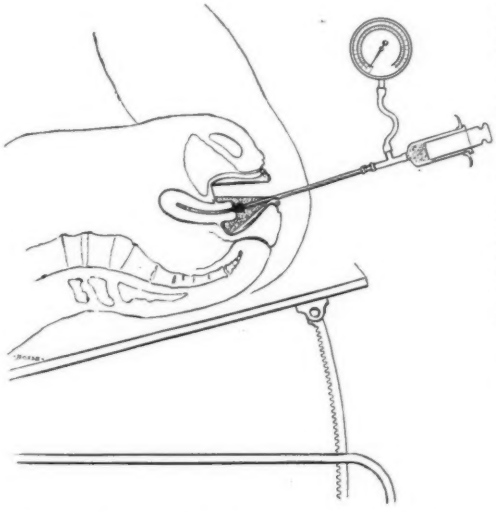

Fig. 1. The cannula is shown passed into the uterus beyond the internal os. The shaded area represents fluid. Should there be an air leak at the external os, it would be appreciated by bubbling in the fluid. The tenaculum used to hold the cervix steady is purposely omitted.

While commending its value, I feel the technique can be greatly simplified. All we wish to demonstrate is the patency of the tubes. This can be done as well with a small amount of gas as with large quantities. With the small amount our patients are spared the shoulder pain.

The capacity of the uterine and tubal cavities has been estimated at about 5 cubic centimeters, although Rubin recently stated he had shown a capacity of 15 cubic centimeters in a uterus and tubes removed by operation. If we inject an amount greater than this maximum without leakage from the apparatus or at the external os, we know that it must have gone into the abdominal cavity.

The apparatus needed for this test is a 30 cubic centimeter syringe that does not leak, a cannula sufficiently long to introduce past the external os, with a rubber urethral tip to prevent escape of gas at the external os, a T connection, manometer to regulate pressure, rubber tubing to make the proper connections, a bi-valve speculum, a vulsellum forceps, and a syringe to fill the vagina with fluid.

The test: The 30 cubic centimeter syringe is filled with carbon dioxide by having the gas from the supply tank displace the piston in the syringe. The flow from the tank should be slow and at low pressure. The patient is put on the examining table, the buttocks elevated, a bi-valve speculum introduced, the cervix

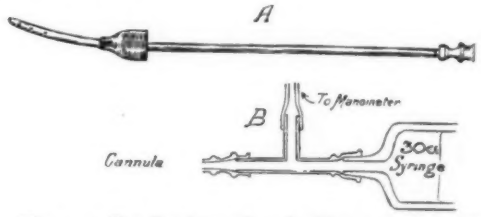

Fig. 2. *a*, Details of cannula and rubber cone; *b*, detail of the T connection.

swabbed with iodine and then grasped on the side with the vulsellum forceps. The cannula is gently introduced and the rubber cone made to fit snugly in the external os. The vagina is then flooded with boracic acid solution so that the external os is covered. The syringe and manometer are then connected. The injection should be slowly made and the pressure as shown by the manometer should not exceed 200 millimeters. Usually in the patent tube cases, the pressure rises to 100 or 120 and then drops to 70–80. If there is any escape of gas at the external os it is readily detectable by the bubbles produced.

This method might be still further simplified by using air instead of carbon dioxide. I doubt very much if the small quantity of slowly absorbable nitrogen would do any damage or even produce discomfort.

A SUCTION APPARATUS FOR THE TREATMENT OF EMPYEMA

By JOHN W. SNYDER, M.D., Rochester, Minnesota
Special Student, The Mayo Foundation

THE need for a practical type of suction apparatus to be used in the treatment of empyema prompted me to make a device which is simple, readily constructed, and meets the requirements of daily use.

Negative pressure is produced by a common hydraulic suction pump procurable from any instrument dealer. The type we have used (Fig. 1) has a thick rubber ring in one end (Fig. 1, *a*) which may be readily attached to any type water faucet by pushing the ring firmly up around the outlet of the faucet. This obviates special plumbing fittings and permits transportation of the apparatus from room to room. Attaching or detaching the pump requires but a moment's time.

A large bottle with a rubber cork containing three perforations is used as a negative pressure chamber and as a receptacle for aspirated fluids (Fig. 1). Metallic or glass tubes are passed through two of the perforations in the cork, one tube (Fig. 2, *a 1*) reaching just through the cork and the second (Fig. 2,*a 3*) for some distance into the bottle. Through the third perforation an inlet tube having two valves is passed (Fig. 2, *a 2*). The upper valve is automatic in action, working against a spiral spring. The tension of the spring may be varied by means of a thumb screw. The second valve placed below the spring valve may be used to cut off the inlet tube from the vacuum chamber when desired.

The third part of the apparatus is a soft rubber bell which is to be applied to the chest. Such a bell can be easily made from a suction device used by plumbers by removing the handle from the apparatus and drilling a hole through the base of the bell into which a tube is fitted.

Fig. 1. Suction apparatus assembled.

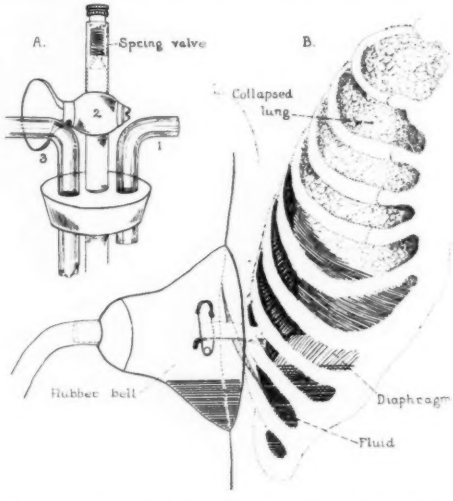

Fig. 2. *a*, Detail of inlet valve; *b*, bell applied to thora

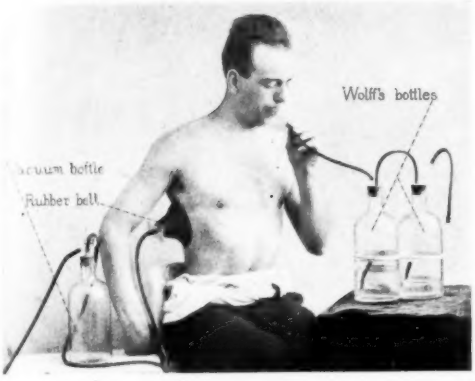

Fig. 3. Apparatus in use.

It is also of advantage to thin the edges of the bell slightly to increase its flexibility.

The apparatus is assembled by connecting the suction pump to the shorter tube in the bottle and by connecting the longer tube to the bell by means of rubber tubing. When ready to use, the pump is attached to any convenient water faucet and the water turned on. The bell is held for a few seconds against the chest wall covering the thoracotomy incision and drainage tubes (Fig. 2, *b*). The suction is sufficient to maintain the bell in contact with the chest wall without additional support. It is flexible enough to adapt itself to any surface adhering closely either to an angular or to a rounded type chest.

The degree of negative pressure maintained may be regulated by varying the tension of the spring valve in the inlet tube, for whenever the vacuum exceeds the tension at which the spring is set, air will be admitted to the vacuum bottle. If desired the valve may be standardized against a column of mercury. The rapidity of flow of the water through the suction pump may also be used to regulate the degree of negative pressure.

Patients do not complain of pain with judicious application of the apparatus. The use of "Wolff blow bottles" while the apparatus is in place (Fig. 3) is of aid in expanding the lung of the affected side. Pus and retained secretions are very readily evacuated from the chest cavity. Any degree of hyperæmia may be produced in the wound by varying the degree of negative pressure. The apparatus is also of advantage in the treatment of other types of suppurating wounds, both because of the hyperæmia produced and by the thorough removal of retained secretions. Intermittent irrigation of empyema cavities with Dakin's solution has been employed in all cases in conjunction with the use of this apparatus.

RADIUM IN CANCER OF THE BLADDER[1]

By GEORGE GILBERT SMITH, M.D., F.A.C.S., Boston
From the Collis P. Huntington Memorial Hospital, Boston

THE treatment of cancer of the bladder by surgical measures alone has, in a rather small proportion of cases, given satisfactory results. In the greater proportion by far, the growth has recurred and all that remained was to ease with morphia the patient's decline. This statement, I think, will be accepted as true by every genito-urinary surgeon of experience.

During the years 1910 to 1915, the acquisition of radium by a number of hospitals and individuals aroused a general interest among urologists as to the value of the element in the management of malignant growth of the bladder. Could radium be used as a substitute for surgery? Was its employment as an aid to surgery productive of results?

In 1916, the Huntington Hospital in Boston began the use of radium in cancer of the bladder. From September, 1916, to January 1, 1921, 24 cases were treated with radium. A number of other cases were seen but not treated, and a few were treated whose later careers were so incompletely recorded that they were of no value as evidence. I shall report today the result of our experiences with these 24 cases.

Very few cases of early carcinoma of the bladder come to the Huntington Hospital. Of the 24 cases in our series, 8 were cases of recurrence after operative removal of a carcinoma; 5 had been operated upon and a growth had been found which was too extensive for removal; 2 appeared after operations for stricture of the urethra; 9 were judged by cystoscopy to be unsuitable for any operation save perhaps the purely palliative procedures of cystostomy and cauterization. There were no benign papillomata in this series, and only one case in which excision of the growth might have been attempted with any success.

Speaking broadly, two types of treatment were used. The earlier method consisted in the application of screened radium emanation to the interior of the bladder, an attempt being made to apply the radium as closely as possible to the region of the tumor. For this purpose, the emanation, in its glass tube, was put into a thin steel needle, and then into a silver capsule with walls 0.5 millimeter thick, carried on the end of of an intra-uterine applicator. The shaft of this was pliable and could be bent in such a way that the capsule at the tip could be applied fairly accurately to that quadrant of the bladder which contained the growth. In other cases, the radium emanation, in a steel needle, in some cases further screened by 0.5 or 1.0 millimeter silver, was placed in the tip of a soft rubber catheter. The catheter was inserted into the bladder and the patient instructed to lie in such position that the catheter would fall toward the affected part of the bladder.

The method which was employed in later cases was the implantation of bare emanation tubes or of steel needles directly into the tumor.

It was first of all necessary to establish a standard dosage, to find, in other words, the number of millicurie hours which might be expected to cause retrogression of the growth, but which would not burn too severely the normal tissues of the b'adder. From a series of cases as small as ours, treated by different methods over a term of years, it is difficult to cull the definite information which we would wish upon this point. Furthermore, there appear to be individual variations in the degree of reaction set up in different individuals by the same dosage. The amount of treatment which has already been given, the degree of cystitis, the type of tumor, the mechanical conditions of drainage (whether the urine has to be voided, is drained off suprapubically, or is excluded altogether from the bladder), all these factors influence the action of radium upon the bladder. The amount of screening is, of course, of importance.

I will give a few observations and try to ascertain from them the general limits of dosage.

Case 3 (Tothill). Woman, age 62, had an extensive carcinoma of the left lateral wall and base of the bladder. The growth was sessile and not ulcerated. Eighty-eight millicuries of radium emanation, screened by 2 millimeters silver, was placed in the tip of a soft rubber catheter and left in the bladder for 5 hours, 36 minutes. Total exposure 492 millicurie hours. She remained in the hospital 9 days after the treatment. Her temperature remained normal, and the only evidence of reaction was an increased frequency of urination at night.

Case 15 (Resnick). Woman, age 66, had a sessile, slightly ulcerated growth on trigone. Patient had had several treatments, the last one having been on February 1; April 20 she had no symptoms referable to the bladder. She was given a treatment, 66 millicuries of emanation screened by 2 millimeters silver, applied to bladder base by means of intra-uterine applicator. The position of the applicator was changed once during the time—4 hours 34 minutes—it was in the bladder. Total dosage, 30

[1] Presented at a meeting of the American Association for Cancer Research, Cleveland, Ohio, March 24, 1921.

millicurie hours. During the next 3 months, the patient showed no signs of radium burns. Cystoscopy, May 20, showed no burn of normal mucosa but did show retrogression of the tumor.

CASE 18 (Robertson). Man, age 50. March 9, 1920. Cystoscopy; on left side of neck of bladder, extending for 1.5 inches above the internal urethral orifice and covering entire left half of bladder neck, is a massive, solid growth, necrotic in places. March 11, 100 millicuries, screened by 0.5 millimeter silver, screwed on to the tip of an intra-uterine applicator, were applied to the tumor for 3 hours. It was rotated once; dosage 300 millicurie hours. April 1: Since last treatment patient has had no hæmaturia or difficulty in voiding, nocturia four times, has gained 3 pounds. A cystoscopic examination was made and the bladder found not burned. The tumor showed reaction as evidenced by redness and œdema. April 15: cystoscopic examination was made and tumor seemed more extensive. Radium treatment, 66 millicuries, applied as before, for 4½ hours. Dosage 300 millicurie hours. May 20: patient has gained 10 pounds; urinates every 1 to 1½ hours; cystoscopy showed shaggy growth all around bladder neck, extending across trigone on to both lateral walls.

Another case (No. 19) developed considerable bladder irritation after 495 millicurie hours, with 1 millimeter silver and 1½ millimeters rubber screening.

CASE 21 showed no reaction after 275 millicurie hours, with 0.5 millimeter silver screening.

CASE 22. Woman with a recurrent carcinoma at the bladder neck, had a period of marked bladder irritability after 95 millicuries, screened by 0.5 millimeter silver and a rubber catheter, had been left in the urethra for 2 hours and 5 minutes (200 millicurie hours).

In two cases in which the urine was excluded from the bladder entirely, large doses of radium were applied intravesically. Case 14 had 1,000 millicurie hours with 0.5 millimeter silver screening. Case 20 had 1,008 millicurie hours, with no screening except that of a rubber catheter, inserted into bladder through the suprapubic sinus. Although in both cases the discharge of pus after radiation was annoying, in neither case was there pain in the bladder or any other subjective symptom due to the radium.

From a study of all our cases, of which the preceding instances are fairly typical, it would appear that 400 millicurie hours, given with a screening of 0.5 millimeter or 1.0 millimeter silver, is a dosage which may be used in the treatment of bladder cancer without any very marked reaction. Large doses in bladders which are subject to the alternate diastole and systole of urination, are likely to set up a reaction which is very painful. If the bladder is drained suprapubically, greater doses may be used, and if the urine is entirely excluded from the bladder, doses of 1 000 millicurie hours do not cause discomfort.

The duration of a reaction of moderate severity is from 4 to 6 weeks. Repeating the treatment in less than 6 weeks gives, therefore, cumulative effect. If, however, no reaction has developed in 3 weeks after the first treatment, it is proper to go ahead with the second treatment.

I have found that hæmorrhage and cystitis often decrease after a single radium treatment.

So much for the technical aspect of dosage. The question now arises: What is the effect of repeated or of single doses upon the cancer? Is the application of screened radium emanation to to the surface of the tumor an effective method of treatment?

In our series 15 cases were treated in this way. Six had a total of less than 600 millicurie hours, 9 had 600 or more. I will briefly summarize these 9.

CASE 1 (Wilde), September, 1916. Woman, age 60. August 1916, she had cystostomy by Dr. L. Davis. In the base of the bladder, easily palpable by vagina, was an infiltrating growth, the size of a silver dollar. Through the suprapubic fistula she was given 6 treatments, aggregating 1,900 millicurie hours, with screening varying from only that of the steel needle in which the glass emanation tube was contained, up to 1 millimeter silver. She was given 280 millicurie hours more by vagina. Five months after beginning this treatment, she died. Autopsy showed a sloughing, necrotic bladder, the wall of which contained carcinoma. There were metastases in the abdominal lymphatics and liver. There was a retroperitoneal abscess, a right perirenal abscess, a right pyo-ureter and pyelitis, left hydro-ureter and hydronephrosis. The carcinoma was not destroyed even locally after 2,180 millicurie hours.

CASE 2 (Magnitzky). Woman, age 67, operated upon by Dr. Horace Binney, April, 1916. In October, 1916, she came to the hospital with recurrent carcinoma of the bladder neck. The base of the bladder was indurated over its entire vaginal aspect. She was given 3 intravesical treatments, totalling 848 millicurie hours, with 0.5 millimeter silver screening, and was given 696 millicurie hours over the lower abdomen. She died of carcinoma of the bladder in June, 1917. No autopsy. This was an evidently hopeless case apparently unaffected by radium.

CASE 8 (Ligotte). Man, age 82. July, 1917, cystotomy was done by Dr. Paul Thorndike. Extensive carcinoma of base of bladder was found, and a suprapubic fistula established. In January and February, 1918, he was given two treatments aggregating 1,287 millicurie hours. Steel needles, unscreened, were inserted into the bladder through the fistula. Death from cancer of bladder occurred in September, 1918. This was an advanced case which was unaffected by radium.

CASE 9 (Martin). Man, age 47, who, on December 1, 1917, had a cystotomy by Dr. W. C. Quinby. An extensive growth involving the trigone and left lateral wall of the bladder was found, and suprapubic drainage instituted. Beginning January 19, 1918, the patient had 6 treatments, extending over a period of 8 months. Steel needles containing radium emanation were put into the bladder through his suprapubic tube. A total dosage of 1,785 millicurie hours was given. At no time was there evidence of untoward reaction. Patient died at his home on December 19, 1918.

CASE 11 (French). Man, age 66. November 6, 1917; operation by Dr. G. G. Smith. A malignant growth near right ureter excised, and a rough area on anterior commissure cauterized. Pathological report: cancer. On February 14, 1918, cystoscopy showed an area of rough appearance on anterior commissure, which suggests cancer. March 2, 1918, 204 millicuries, screened only by steel needle and rubber catheter inserted so as to lie just inside bladder orifice. Left in for 3 hours, total 612 millicurie hours. Patient was not seen again, but telephoned that

he was having a great deal of bladder trouble. Died July 3, 1918. No autopsy. A case of localized malignant growth of bladder neck, treated once. In this case 612 millicurie hours proved ineffective in checking growth.

CASE 14 (MacBeth). Man age 61. Bladder full of shaggy growth. Operation, December 3, 1919. Dr. G. G. Smith. Five papillomatous growths were removed, bases cauterized, no apparent induration of bladder wall. Two bare emanation tubes of 8 and 6 millicuries respectively buried in cauterized area outside of right ureter. These total 1,864 millicurie hours. Specimen showed carcinoma. March 18, 1920, cystoscopy; bladder wall smooth except for a necrotic area, 2 centimeters in diameter, surrounded by a zone of heaped up, deep red tissue, outside of right ureter. Given radium treatment, 150 millicurie hours, screening 1 millimeter silver and rubber catheter. May 6, he was given 219 millicurie hours, screened by 0.5 millimeter silver. June 3, he was given 300 millicurie hours, screened by 0.5 millimeter silver. August 28, his symptoms of bladder irritability were worse, and cystoscopy showed papillary masses of necrotic tissue rising from the right lateral wall. His tumor had grown, although he had had 669 millicurie hours radium besides the 1,864 millicurie hours introduced at operation. The neck of the bladder was red and œdematous, evidently a reaction to the radium. A bilateral ureterocolostomy was done in October, 1920. He did well and was given 1,000 millicurie hours, 0.5 millimeter screening, intravesically on November 24, 1920. He then went home to Providence, but a letter received March 12 stated that he was suffering greatly from pain in back and legs and was too ill to be brought to the hospital.

CASE 15 (Resnick). Woman, age 66. January 3, 1920. Cystoscopy showed the base of the bladder from above the ureters to the urethral orifice to be covered with a sessile, irregular, non-ulcerated growth. Palpation of base of bladder detects several smooth, firm nodules, the size of beans in the vesicovaginal septum. January 7: 2 bare emanation tubes of 3 millicurie each were inserted into the largest nodules through an endoscope. January 29: bleeding stopped; there is more frequency of urination and some ardor urinæ; cystoscopy shows no appreciable change; 1,155 millicurie hours, screened by 2 millimeters lead applied to base of bladder by vagina. February 11: 730 millicurie hours, screened by 2 millimeters lead, applied by vagina. February 12: 276 millicurie hours, screened by 1 millimeter silver, applied intravesically by means of intra-uterine applicator. March 18: no symptoms now; cystoscopy showed trigone free from growth except for 1 nodule, size of cherry, near right ureter. This mass is palpable by vagina. Close to bladder neck, on right, the mucosa is thickened. April 15: cystoscopy showed on right side of trigone an elevated mass about 1 inch in diameter, with necrotic areas. April 20: 300 millicurie hours screened by 1 millimeter silver introduced into bladder on intra-uterine applicator. May 20: cystoscopy showed 2 nodules near right ureter, small nodule near left; 400 millicurie hours applied by vagina, 2 millimeters lead screening. Nov. 4, 1920: lately has had some frequency and hæmaturia. Cystoscopy showed 2 solid tumors, each about 1 centimeter in elevation and 2 or 3 centimeters in diameter. Some roughening of the mucosa on right side of trigone. November 30, 1920, cystotomy: a circular growth, 2 centimeters in diameter surrounding left ureter. Into this were inserted 3 bare tubes totalling 20 millicuries. To right of urethra a growth 2 by 0.5 centimeters in to which were put 3 "seeds," aggregating 11 millicuries. Outside right ureter is a growth 3 by 2 centimeters, 1 centimeter high. This was leveled off with the cautery and into the base were inserted 3 seeds amounting to 22 millicuries. Thus a total dosage of 6,800 millicurie hours was given. The bladder was drained suprapubically for 3 weeks. During convalescence the patient had a good deal of bladder pain. She was discharged January 3, 1921. March 10, 1921: cystoscopy showed great masses of necrotic tissue about the base of the bladder. The ring of growth about the left ureter was gone, leaving a zone of necrosis. The patient was feeling fairly well and her condition was improving.

This case showed very definite improvement following screened radiation from bladder and from vagina. After an initial improvement the growth again became active and was treated by open operation and implantation of bare emanation tubes. Final result as yet unknown.

CASE 18 (Robertson). A man of 50 who had had hæmaturia for 2 years. March 6, 1920, cystoscopy: "On left side of bladder extending for 1 or 1½ inches above urethral orifice and occupying entire left side of bladder neck is a massive, solid growth, necrotic in places, apparently continuous with the prostate. Prostate by rectum feels small and soft."

March 11 he was given 300 millicurie hours, 0.5 millimeter silver screening. April 15 this was repeated. Cystoscopy; tumor seems more extensive. May 20: patient has been working and has gained 10 pounds; no hæmaturia; voids every hour or hour and a half. Cystoscopy: shaggy growth all about bladder neck, extending across trigone and on to both lateral walls. Ureterosigmoidostomy was done. The patient had postoperative intestinal obstruction. He was explored and a definite obstruction freed, but he died 5 days later. No autopsy could be obtained. 600 millicurie hours did not check the growth.

CASE 19 (Boston). Man, age 52. April 12, 1920. Bladder appeared to be full of a shaggy growth. April 15: 495 millicurie hours radium emanation, screened by 1 millimeter silver, contained in soft rubber catheter. Position of the catheter was changed 3 times during the treatment. May 13: has had considerable bladder reaction; now better. June 3, patient working on the road, urine less foul. Cystoscopy: 3 or 4 sloughing papillary growths on left lateral wall and on trigone. Somewhat less growth, less cystitis. June 17, has had to stop work because of bladder trouble. Given 243 millicurie hours, screened by 0.5 millimeter silver. July 8: passes pieces of slough. Base of bladder above prostate feels indurated; much frequency. Operation advised, but patient did not return. A letter states that he died in December, 1920, of cancer of bladder.

CASE 24 (Belcher). Woman, age 76. Cystoscopy, June 9, 1920: trigone covered with necrotic growth. Another area back of left ureter. June 8: 91 millicuries, screened by 0.5 millimeter silver, left in bladder for 3.5 hours. Total 300 millicurie hours. July 1: symptoms improved. Cystoscopy: less slough, growth smaller. Ureters not visible. July 15: 99 millicuries radium, screened by 2 millimeters lead, applied to base of bladder from vagina side for 8 hours. August 19, cystoscopy: trigone apparently free of growth, a few small buds in right base; 110 millicuries, screened by 0.5 millimeter silver, applied to right base of bladder on intra-uterine applicator, for 7 hours. October 7: can hold urine for 2 hours, urine clear. One necrotic papilloma near right ureter. A few buds at right base. October 21: a necrotic growth 2 centimeters in diameter near right ureter. Masses of slough about the bladder neck. November 18: 126 millicuries, screened by

2 millimeters lead, applied by vagina for 4 hours. December 7, growth is increasing, has had 1,900 millicurie hours. December 21, cystotomy: ulcerated area about bladder neck and on trigone. A bit excised. Pathological report: necrosis and inflammatory changes. Some small arteries containing organized thrombi; no carcinoma.

Three bare emanation tubes of 3 millicuries each were inserted—1,200 millicurie hours. Three needles aggregating 44.5 millicuries were left in the tissues about the bladder neck for 24 hours—1,078 millicurie hours. The patient lived for 6 weeks, gradually failing. Autopsy: "Annie Belcher: microscopic notes. None of the numerous sections through the wall of the urinary bladder and neighboring tissue shows carcinoma. There is an acute purulent cystitis, ureteritis (bilateral), and inflammation (acute pyonephrosis) of the kidneys. Lymph-glands show acute inflammation. The bladder wall is considerably thickened by an increase of dense fibrous tissue between the muscle bundles, indicative of long-standing chronic cystitis.

It may have been that in this case the carcinoma had been already destroyed by radium before operation. As a result of two treatments—800 millicurie hours within the bladder, 800 millicurie hours by vagina—a fairly extensive and certainly inoperable growth was almost entirely cleaned up. It began to grow again, howe er, and increased in spite of 300 millicurie hours intravesically and 500 millicurie hours vaginally.

Of the 6 cases treated with less than 600 millicurie hours, none showed improvement worth noting. Of the 15 cases treated by screened radium emanation inserted into the bladder, only 3 showed any marked improvement. This improvement, in Case 19, lasted about 1 month; in Case 15 it persisted for 7 months at least; in Case 24 the cancer may have been destroyed before cystotomy.

The use of screened radium emanation introduced into the vesical cavity, while not wholly ineffectual, was far from encouraging. Although in some cases the amount of treatment was undoubtedly too small, the cases given treatment to the point of burning the bladder were sufficient in number to convince us that a more intimate application of the radium to the tumor was desirable. In our later cases we have, therefore, tried to get the radium directly into the tumor. In 3 cases this was done without opening the bladder; in 3 it was done by cystotomy.

Case 15 has already been described. Two "seeds" were inserted through an endoscope; the number of seeds was inadequate to the size of the growth.

Case 17 (Kettleman). Man, age 67. Cystoscopy, February 17, 1920, showed a large adenomatous prostate. On the anterior vesical wall just behind the anterior commissure of the prostate was a partly necrotic, sessile tumor, about 2 centimeters in diameter. March 3, with cystoscope in the bladder, a long needle bearing in the tip 68 millicuries of radium emanation was inserted through the space of Retzius until the tip could be seen issuing from the tumor. It was then withdrawn slightly and left in position for 3 hours. (Total 204 millicurie hours.) March 18, the tumor had almost disappeared. May 13: no sign of the tumor. I could not see the bladder wall close behind the prostate, so by means of an intra-uterine applicator I applied 138 millicuries, screened by 2 millimeters silver, to the anterior bladder wall for 1 hour, 30 minutes (200 millicurie hours). March 10, 1920: the patient returned for examination. He had gained weight and looked well. He had no bladder symptoms. Cystoscopy showed no sign of tumor in the bladder.

Case 22 (Mrs. Quinn). Woman, age 28, from whose bladder a papillomatous growth the size of a horse-chestnut had been removed at the Boston City Hospital. The operation was on February 28, 1919. June 24, 1920, hæmaturia reappeared. Cystoscopy, July 22, showed a solid, rounded tumor, the size of a marble, rising from right bladder neck. A needle containing 125 millicuries radium emanation was passed through the vesicovaginal septum into the tumor and left for 4 hours—(500 millicurie hours). August 19: tumor reduced one-half; 424 millicurie hours applied by vagina. October 21: endoscopy gives good view of a tumor, size of pea, close to internal orifice. Through the endoscope a needle bearing 28 millicuries was inserted into the tumor, and left for 8 hours (224 millicurie hours). December 2: tumor is gone, white slough at neck of bladder. Patien is 2 months pregnant. February 3, 1921: no growth seen, considerable slough about bladder neck. Patient has had a severe attack of cystitis. February 10, 1921: 95 millicuries, screened by 0.5 millimeter silver, placed in catheter and left in bladder neck for 2 hours, 5 minutes (200 millicurie hours). March 5: patient is having a good deal of bladder distress.

The three cases in which bare tubes were implanted by cystotomy have already been described.

Case 14 had two seeds of 8 and 6 millicuries (1,862 millicurie hours) implanted and 8 months later showed a definite recurrence.

Case 15 had seeds totalling 53 millicuries (7,049 millicurie hours) implanted on November 30, 1920, and 3½ months later showed a great mass of necrotic tissue in the regions so treated. Whether there is still cancer present, cannot yet be told.

Case 24 had seeds and needles implanted totalling 2,278 millicurie hours. At autopsy 6 weeks later no carcinoma could be found.

I am painfully aware of the incompleteness of this series of cases. In many the diagnosis was never made microscopically, although in practically all the diagnosis was made by several cystoscopists. There were but few autopsies upon the cases that died, and as for the few patients still alive, sufficient time has not elapsed to prove the value of this treatment. Certain conclusions, however, have formulated themselves in my mind, to form a starting point for further work.

CONCLUSIONS

1. It is useless to attempt to cure with radium infiltrating carcinomata which involve large portions of the bladder wall. Necrosis of the

bladder will be brought about by any dosage which will materially influence the tumor.

2. Certain superficial cancers of the bladder may be reduced in extent by the application of screened radium emanation to their surface. This may occur without necrosis of bladder wall.

3. To accomplish this effect, 400 millicurie hours, with screening of 0.5 millimeter silver, applied not oftener than once in 6 weeks, has been successful, and has not caused any considerable reaction in the bladder.

4. The greatest effect is produced by the first 3 or 4 applications of radium.

5. If the tumor begins to grow again, further treatment with radium applications has little deterrent effect.

6. The best way to employ radium in cancer of the bladder is by the implantation of bare emanation tubes in the tumor, allowing one tube to each cubic centimeter. Steel needles containing radium may be employed in the same way, except that they must be withdrawn after adequate exposure has been made.

7. The necrosis caused by the implantation of radium in bladder tumors persists for at least 3 months.

THE TREATMENT OF GONOCOCCAL ARTHRITIS WITH ASPIRATED SYNOVIAL FLUID INJECTED INTRAMUSCULARLY

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SOON after the advent of auto-serotherapy, we began its use in the treatment of hydroceles and in gonococcal arthritis where there was an accumulation of synovial fluid. Our experience so far has shown us two outstanding facts in connection with this form of therapy:

1. Little benefit may be expected from it when the hydrocele or synovial fluid is non-infected and free from pus cells, except in the acute traumatic conditions.

2. Prompt improvement and remarkable cures have resulted in all of the patients with acute gonococcal arthritis. Since we began to employ this method of treatment, we have found it unnecessary to resort to any other plan, such as vaccines, sera, local applications, fixation, vesiculotomy, etc.

We desire to report the results in 27 patients treated by this method alone. Restoration to normal has been prompt in all of the acute cases, the relief of pain occurring nearly always within 24 hours. The ultimate results have been equally gratifying: no ankylosis, complete or partial, has followed this plan of treatment. In addition to the improvement in the joints, similar results were noted in the cessation of the symptoms of complicating acute conditions, such as epididymitis, prostatitis, posterior urethritis and seminal vesiculitis. There has been an immediate drop in the temperature in those patients with hyperpyrexia. In one instance the temperature was lowered five degrees in 12 hours.

The treatment is naturally only available for those patients who have a collection of fluid in the synovial space.

The reactions following the injections were usually mild or absent. There was definitely less soreness at the sight of the injections than usually follows an average dose of mixed gonorrhœal vaccine, and in no instance did an abscess form or was there a persisting induration.

All of the injections were given into the gluteal muscles. The piston of the syringe was withdrawn sufficiently to determine that the needle had not entered a blood vessel. These injections were repeated every 2 to 7 days; the amount injected varied from 15 to 50 cubic centimeters. At first the doses were small due to our apprehension; later when we found that no trouble was produced by the injection, the amount was increased. We are now under the impression that the larger doses are the best, in spite of the slight occasional increase in the reaction and the production of chills and a momentary rise in temperature. The average number of injections administered to each patient was three. The fluid, however, was injected as long as there was any of it to be aspirated.

As there is a tendency for the synovial fluid which is left to be absorbed, it is better to repeat the injection every two or three days; although the absorption of the fluid apparently has a beneficial effect it was not to the same extent that was observed when the fluid was injected intramuscularly. The injections were given in the muscle rather than in the subcutaneous tissue because we thought it offered greater resistance to the organisms present in the fluid and that there would be less tendency for abscess formation.

In one patient there was an accumulation in both knees. The fluid was only aspirated from the right one but the left knee subsided with nearly the same promptness as the right.

Since we began the use of this treatment of acute gonococcal arthritis, we have not had occasion to employ any other method of therapy and we are convinced that there is now no other method so uniformly effective.

Practically the same beneficial results followed the injection of hydrocele fluid when the condition was acute and inflammatory; coincident epididymitis, urethritis, and seminal vesiculitis disappearing more quickly than usual.

Clear sterile fluid. In only a small percentage of the patients in whom the fluid, either from the joint of the tunica vaginalis, was clear and free from infection, was any of the results satisfactory.

Acute traumatic synovitis. Dr. Le Roy W. Childs, who for a number of years has been surgeon for the Athletic Association of the Georgia School of Technology, and who has had considerable experience in the treatment of traumatic joints, in which there was a collection of synovial fluid, has employed the plan of injecting the fluid drawn off, in a series of 16 cases. He states that undoubtedly the patients made more prompt recoveries from these injuries when treated in this manner than did the patients in whom the fluid was merely drawn away and not re-injected.

Theory as to modusoperandi. One can see how nature might store antitoxic and antibactericidal substances in this fluid when infection is present, but such a theory would not explain the results of the sterile traumatic conditions. As this is only a preliminary report, we will not enter a discussion as to the process by which these results were obtained, but will take up that phase of the subject in a later communication.

CASE REPORTS

One case history will be given in considerable detail because it was the result which aroused our interest in this method and because we believe it may elicit the interest of others who may find an opportunity to employ it in other conditions which do not come under our observation or care.

Mr. C. A. F., age 47, lumberman, reported for treatment April 7, 1915, complaining of frequent urination for 8 years which had gradually grown worse until he had to void every 10 to 30 minutes; he had chills, fever, etc., which had been worse since an attack of influenza in January, 1915. He had a tubercular hip since a young man. The urine was so thick with pus and blood that it looked like bloody milk. His voice was husky from tubercular laryngitis. This diagnosis was made by a laryngologist. Tubercle bacilli were found in the sputum and in the urine. There was a hydrocele on the right side and the epididymis was tender and about the size of a large lemon. He stated that this had been swollen for a year and a half and that an abscess had formed 15 months previously. The abscess drained and was followed by a fistulous opening which persisted 6 months.

A cystoscopic examination showed the bladder markedly inflamed with many large, ulcerated areas. The verumontanum was in the bladder cavity as if a large ulcer had destroyed a segment of the internal sphincter. Tubercle bacilli and pus were found in the catheterized specimen of urine from both kidneys.

We decided that there was nothing we could do for him to relieve his condition and advised him to go back to the country where he could get plenty of fresh air, good food and sunshine. Before he left, he asked if we could not do something for the swelling in the scrotum. We informed him that we could tap the hydrocele and momentarily reduce the size of the mass. Then it occurred to us that nature might by some good fortune have accumulated in this fluid some antitoxic substances and so we told him that perhaps some of this fluid re-injected might benefit him and as the prospects seemed utterly hopeless, he was given 18 cubic centimeters of the fluid drawn from the hydrocele which contained enough of pus cells to make it look like cloudy urine. He returned in 2 days and said he was better, that there was less frequent urination and less blood in the urine. He was then given 25 cubic centimeters of the fluid and in 2 days reported that he was a great deal better. The injections were continued every 2 or 3 days for 3 weeks, at which time no more fluid could be obtained. The urine at that time looked like cloudy urine instead of like bloody milk, and the blood had been absent for a week. The epididymis had reduced to about one-fourth its former size and was no longer painful.

There was a rapid gain in weight; the tubercular larynx became normal and no tubercle bacilli could be found in the urine. The urine, however, did not become clear and there were periodic attacks of cystitis.

One year later he returned with a large painful mass in the region of the left kidney. For three weeks there

had been chills and fever and the urine was milky with pus. The mass was found to be a pyonephrotic kidney, which was drained. The kidney on the right side being nearly normal, the left one later was removed. The recovery was normal and there was a rapid gain in weight and strength. The urine soon became clear and there had been no return of the tubercular process. He is in good health, attending to his saw-milling in Southern Alabama. His chief complaint when last seen was that he had gotten too fat for his clothes and that the "profiteers" made it impossible to buy more.

We have seen one other less severe pulmonary tubercular infection with an epididymitis and a hydrocele. The injection of the hydrocele fluid, which contained a few pus cells but no demonstrable organisms, caused a reduction in temperature and a gain in weight, but the epididymitis did not respond to the treatment. An epididymectomy was performed and the fistulous tract incised. Not more than 6 months have elapsed and while he is definitely better, his condition is not normal and we do not think he will obtain a satisfactory result like the first reported.

CASE 1. Turk, aged 17, gonorrhœa 4 months; all glasses of urine cloudy; slight urethral discharge; prostate gland enlarged and much pus in the secretion expressed. The right knee had been painful and swollen for 2 weeks. Twenty cubic centimeters of the synovial fluid was aspirated into a sterile syringe and injected into the gluteal muscles. The fluid contained many pus cells but no gonococci could be demonstrated in the stained smear. The patient returned in 2 days with less pain and less swelling in the knee. Twenty cubic centimeters of the fluid was withdrawn and injected. In 2 days more the pain had almost disappeared and only 15 cubic centimeters of the fluid could be aspirated. This was injected into the buttocks. Within 5 days more the knee was practically normal, the urine was clearer although it still contained mucous shreds and pus cells were present in the prostatic secretion. Urethral irrigations and an occasional massage of the prostrate gland soon completed the cure. There was no tenderness at the sight of the injection nor was there an indurated mass.

CASE 2. White, male, age 23; gonorrhœa 5 weeks; slight frequency in urination; slight enlargement of the prostate gland; no epididymitis; swelling and redness of the right knee one week ago. Fifteen cubic centimeters of cloudy fluid was aspirated and injected into the buttocks. Within two days the painful symptoms were much better and the ankle less swollen. Twenty cubic centimeters of fluid was aspirated and injected. Five days later he was practically well and there was no fluid to aspirate. Irrigations, prostatic massage, etc., were continued until the urine became clear and the prostatic secretion free from pus cells.

CASE 3. Physician, age 29; hyperacute gonorrhœa; enormously swollen left knee; very tender. Profuse urethral discharge, epididymitis and all glasses of urine cloudy; frequent and painful urination; temperature 103°. Thirty cubic centimeters of fluid was aspirated; there were many pus cells in it and gonococci. The fluid was under much pressure in the synovial space. The injection was made as usual and was followed by considerable general reaction and a rise of temperature with chills, aching in other joints much like influenza. Within 24 hours there was a fall of 4 degrees in temperature and a decided reduction in pain. In 48 hours the patient was comfortable, the swelling of the knee greatly reduced, a considerable amount of the synovial fluid having been absorbed during the 2 days following the injection. The patient was then able to walk. Three days after the first injection 40 cubic centimeters of fluid was withdrawn and injected. The second treatment was followed by a slight reaction. In 4 days the remaining fluid, 35 cubic centimeters, was aspirated and injected. In 2 weeks the knee was normal. During this time there was an equally rapid cessation of the urethral symptoms and in the subsidence of the inflammation of the epididymis.

CASE 4. Greek, age 24: acute gonorrhœa 4 weeks ago, followed by considerable pain and frequency of urination; no epididymitis. The left knee became red, painful and swollen during the third week. Twenty-five cubic centimeters of fluid was aspirated and injected. The fluid contained pus cells but no organisms could be demonstrated in the stained smear. In four days the patient returned with distinct improvement, less pain, and less swelling in the knee. Thirty cubic centimeters of fluid was again injected and in 4 days 25 cubic centimeters was given intramuscularly. The recovery was uneventful; the reactions were less than those usually occurring after the average doses of vaccine.

CASE 5. Male, age 28; gonorrhœa 7 weeks; arthritis left knee three weeks; no complications except prostatitis. The treatment and result were practically the same as in Case 4, except that four injections were given at two-day intervals; recovery was prompt and uneventful.

CASE 6. Male, 32; gonorrhœa 1 month; prostatitis and seminal vesiculitis; arthritis of both knees, with considerable swelling. Thirty cubic centimeters of cloudy fluid was withdrawn from the right knee and injected into the gluteal muscles. Three days later he reported with both knees much better and the urgency of urination greatly reduced. The same amount of fluid was aspirated from the same knee and injected. This was repeated in 4 days, after which the recovery was uneventful. It is of interest to note that the fluid from the right knee cured the left one, though the swelling disappeared somewhat more slowly than in the right, which was aspirated.

CASE 7. Practically the same as Case 6, except there was seminal vesiculitis, prostatitis, and epididymitis which rapidly subsided along with the cure of the arthritis in the left knee; three treatments being administered.

CASE 8. Gonorrhœa 3½ weeks; arthritis right knee and right ankle; two doses 40 cubic centimeters each, from the knee with an interval of 3 days affected a cure in 10 days.

CASES 9 to 27; so slightly do these cases differ from the acute gonococcal ones reported that it is needless to go into details. They were promptly cured in much less time than is ordinarily required and in no instance were supplementary remedies employed.

We believe that the principle involved and the success obtained by this plan of treatment may be logically extended to other conditions where more or less similar processes develop, such for instance as tubercular pleurisy with effusion.

Case 28 is added to those above reported because of its interest as a negative result though it does not properly belong in the group of acute gonorrhœal arthritis, because of its long standing and being non-gonorrhœal in character.

Gonorrhœa was acquired in 1916, followed by prostatitis, chronic. Urine now (2 years later) showed only a few mucous shreds and there was no urethral discharge. Considerable pus was in the prostatic secretion. In a stained smear from a condom specimen there were abundant normal spermatozoa with practically no pus cells. About 1 year ago the right knee became swollen but not very painful; the swelling increased and decreased very rapidly without treatment and was very variable. Much walking made it increase and rest made it decrease in size. Aspirated fluid showed no gonococci but considerable pus and staphylococci. The fluid was different in character from that of patients who had acute gonococcal infections; it was thick and tenacious, looking somewhat like gelatine. This type of arthritis was entirely different from the acute gonorrhœal ones in all of its characteristics and failed entirely to respond to the injections of the aspirated fluid, even after twelve doses of 50 cubic centimeters each. Little reaction, local or general, followed the injections and while slight improvement occurred at times, there were no lasting results. Autogenous vaccine was grown and administered with the same negative results; the reactions, however, were more severe than those from the fluid.

Why this type of arthritis failed to respond as did the acute gonorrhœal ones, we cannot say. Whether other cases more or less similar will fail in the same way, we are unable to state as this is the only one of this kind which has come under our observation.

EDITORIAL

SURGERY, GYNECOLOGY AND OBSTETRICS

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NOVEMBER, 1921

GASTRO-INTESTINAL UNION FOLLOWING PARTIAL GASTRECTOMY FOR CANCER

WHEN Péan, in 1879, performed the first resection of the stomach for cancer he was suddenly confronted with a surgical situation which he met brilliantly, but did not follow. Rydygier, in 1880, performed the second operation and appears to have had a clear idea of what he did and why he did it. To Billroth, the master surgeon, belongs the credit for the first successful radical operation for cancer of the stomach. Billroth, born in Germany of Swedish parents, was a surgeon, a statesman, and a musician, a man of originality and of great learning. He was the father of modern initiative surgery in his conception of the necessity for surgical attack on disease in its earlier and curable stages.

In Billroth's first resection of the stomach for cancer he restored the continuity of the gastro-intestinal tract by direct union of the duodenum to the end of the amputated stomach. This method limited the scope of the operation since if there was a considerable gap between the end of the duodenum and the stump of the stomach, the tension was dangerous, and the angle at the point at which the amputated end of the stomach was reduced to the size of the duodenum often leaked. This point was named "the fatal suture angle." In Billroth's second method these technical defects were overcome by a separate gastrojejunostomy after complete closure of the duodenum and the end of the stomach; this is a preferred operation today.

Kocher modified Billroth's Method I by closing the end of the stomach completely and implanting the end of the duodenum into the posterior wall of the stomach. Kocher tried to overcome the element of tension by mobilization of the upper duodenum, but it proved to be open to the same objections as the Billroth Method I, and could be used only in cases in which the growth was small and close to the pylorus. The same objections applied to resection of the stomach in continuity for cancer. Pólya successfully modified the operation by closing the end of the duodenum and implanting the amputated end of the stomach into the side wall of the upper jejunum and bringing the gastrojejunal anastomosis behind the colon through an opening in the transverse mesocolon. This method had the advantage of eliminating one step in the Billroth II operation. Neither the Billroth II nor the Pólya operation, however, permitted attack on the more extensive growth of the stomach in which, after removal of the diseased portion, there was not sufficient room on the posterior wall for the independent gastro-enterostomy of the Billroth II, or sufficient length to bring the end-to-side anastomosis of Pólya below the transverse

mesocolon. Balfour modified the Pólya operation by bringing the jejunum anterior to the colon, a technical manœuver which is extraordinarily efficient since it permits a satisfactory anastomosis to be made, no matter how small a part of the stomach remains.

Moynihan has recently described a new method of restoring the gastro-intestinal tract after partial gastrectomy which has advantages in the hands of highly skilled technicians. The upper jejunum is divided, the distal end is turned in, and the stump of the stomach applied end-to-side, as in the Pólya method. The proximal jejunal end is then anastomosed to the lateral wall of the attached jejunum below the level of the transverse mesocolon.

The poor general condition of some of the patients, however, renders a radical one-stage operation of any type extremely hazardous. Crile and Lilienthal advocate the two-stage operation, first doing the gastro-enterostomy and after some days removing the diseased portion of the stomach. In debilitated patients this method has great merit because the success of the operation, so far as mortality is concerned, depends largely on a successful gastro-intestinal anastomosis. The two-stage operation, however, has the disadvantage that handling carcinoma of the stomach twice doubles the ever present liability of detaching cancer cells which may graft on the peritoneum, and especially on the site of the ruptured ovarian follicles where ovarian metastasis may develop with such rapidity as to obscure the primary disease. In both the female and the male secondary grafts are prone to occur on the lower sigmoid which may be felt digitally through the rectum as the "rectal shelf" of Blumer. Again, secondary resection does not always permit as careful removal of the glands as the primary operation. Our experience with the two-stage operation has been very favorable so far as mortality is concerned, since practically all of the patients who survived the gastro-enterostomy and gained sufficiently to undergo the resection recovered from the radical operation. A number of patients, however, who could have had a resection primarily, for one reason or another never had the resection after the gastro-enterostomy was performed. The two-stage operation improved mortality statistics by eliminating the bad risks, but it diminished the number of patients who were given the chance of cure.

Peck has made a very helpful suggestion, that the gastro-enterostomy be made first in debilitated patients, and, if the patient's condition seems to warrant it, resection immediately, or if not, completion of the operation at a second stage.

The X-ray and improved methods of clinical diagnosis are greatly increasing the number of patients with cancer of the stomach who come to the surgeon in a curable condition. On a proper choice of the method of restoration of the gastro-intestinal tract much of the success of the operation depends.

WILLIAM J. MAYO.

CORRESPONDENCE

THE SURGICAL PATHOLOGY OF RANULA

A Correction

To the Editor: In an article entitled "Ranula of Branchial Origin," by Louis Carp, of New York, which appeared in the August, 1921, issue of SURGERY, GYNECOLOGY AND OBSTETRICS I find that both Robert M. Lewis, of Baltimore, and myself are grossly misquoted. The references are to my article, "A Contribution to the Surgical Pathology of Ranula," in SURGERY, GYNECOLOGY AND OBSTETRICS, 1919, xxix, 447, and to that of Lewis, "A Further Note on the Etiology of Ranula," *ibid.*, 1920, xxxi, 82.

Carp writes: "They (i.e., Lewis and Skillern) are of the opinion that the origin of the ranula and the cyst *is in the sublingual gland* (italics mine). In a previous operation for ranula, Skillern's case had the submaxillary gland removed. Wherefore, he comes to his conclusion by a process of elimination." Closer reading of my article would have shown in the first instance that the notes of the surgeon who performed the primary operation state "the submaxillary salivary gland *as well as the sublingual* were dissected out and the wound was closed"; and secondly, my own statement as follows: "I imagine that much of the confusion that has arisen in the interpretation of the surgical pathology of ranula could be dispelled by restricting the application of the term to the condition described above and illustrated by my case, namely, to *hydrops of the sublingual bursa of Fleischmann.*" In my article is a cut showing the surgical anatomy of Fleischmann's bursa. In Lewis's patient, too, both the submaxillary and the sublingual salivary glands had been removed to do away with the cyst, which also recurred. And Lewis writes: "The findings in my case were almost identical with Skillern's, and I am forced to agree with him in his conclusion that, as has been suggested by Fleischmann and others, some ranulæ arise through disease of the sublingual bursa alone."

Philadelphia P. G. SKILLERN, JR

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

OPERATIVE SURGERY, FOR STUDENTS AND PRACTITIONERS. By John J. McGrath, M.D., F.A.C.S. 6th ed., revised. Philadelphia: F. A. Davis Company, 1921.

DISEASES OF CHILDREN DESIGNED FOR STUDENTS AND PRACTITIONERS OF MEDICINE. By Herman B. Sheffield, M.D. St. Louis: C. V. Mosby Company, 1921.

MORTALITY STATISTICS, 1919. Twentieth Annual Report. Washington: Government Printing Office, 1921.

LES EXTRAITS HYPOPHYSAIRES EN OBSTÉTRIQUE ET EN GYNÉCOLOGIE. By Dr. Léon Pouliot. Paris: L'Expansion Scientifique Française, 1921.

MANUAL OF OPERATIVE SURGERY. By John Fairbairn Binnie, A.M., C.M.(Aberdeen), F.A.C.S. 8th ed., revised and enlarged. Philadelphia: P. Blakiston's Son & Co., 1921.

INFECTIONS OF THE HAND; A GUIDE TO THE SURGICAL TREATMENT OF ACUTE AND CHRONIC SUPPURATIVE PROCESSES IN THE FINGERS, HAND AND FOREARM. By Allen B. Kanavel, M.D. 4th ed. Philadelphia and New York: Lea & Febiger, 1921.

OPERATIVE SURGERY. By Shelton Horsley, M.D., F.A.C.S. St. Louis: C. V. Mosby Company, 1921.

GENERAL PATHOLOGY; AN INTRODUCTION TO THE STUDY OF MEDICINE, BEING A DISCUSSION OF THE DEVELOPMENT AND NATURE OF PROCESSES OF DISEASE. By Horst Oertel. New York: Paul B. Hoeber, 1921.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY; a new and complete dictionary of the terms used in medicine, surgery, dentistry, pharmacy, chemistry, nursing, veterinary science, biology, medical biography, etc., with pronunciation, derivation, and definition, including much collateral information of an encyclopedic character. By W. A. Newman Dorland, A.M., M.D., F.A.C.S. 11th ed., revised and enlarged. Philadelphia and London: W. B. Saunders Company, 1921.

A MANUAL OF MIDWIFERY; FOR STUDENTS AND PRACTITIONERS. By Henry Jellett, B.A., M.D.(Dub. Univ.), F.R.C.P.I., L.M., and David G. Madill, B.A., M.B., B.Ch., B.A.O.(Dub. Univ.), L.M. 3d ed. New York: William Wood & Company, 1921.

SURGICAL ASPECTS OF DYSENTERY INCLUDING LIVER-ABSCESS. By Zachary Cope, B.A., M.D., M.S.(Lond.), F.R.C.S.(Eng.). London: Henry-Frowde Hodder & Stoughton, 1920.

DIE OERTLICHE BETAEUBUNG, IHRE WISSENSCHAFTLICHEN GRUNDLAGEN UND PRAKTISCHE ANWENDUNG. By Prof. Dr. Heinrich Braun. 6th ed. Leipzig: Johann Ambrosius Barth, 1921.

GOUT. By Llewellyn Jones Llewellyn, M.B.(Lond.). With a Section on Ocular Disease in the Gouty by W. M. Beaumont. St. Louis: C. V. Mosby Company, 1921.

DIATHERMY; ITS PRODUCTION AND USES IN MEDICINE AND SURGERY. By Elkin P. Cumberbatch, M.A., B.M. (Oxon.), M.R.C.P. St. Louis: C. V. Mosby Company, 1921.

THAT BOGEY MAN THE JEW. By G. Frank Lydston, M.D. Kansas City: Burton Publishing Company, 1921.

AMERICAN COLLEGE OF SURGEONS

HOSPITAL STANDARDIZATION

FROM REPORT FOR 1921, INCLUDING LIST OF 568 GENERAL HOSPITALS OF 100 OR MORE BEDS IN THE UNITED STATES AND CANADA WHICH MEET THE MINIMUM STANDARD OF THE COLLEGE

THE following pages contain a report on the standardization of hospitals for the year 1921. Since the inception of this movement in 1915, and after the minimum standard was evolved from the combined experience of surgeons, internists, and hospital executives, it has met with increasing recognition, until today 74 per cent of the hundred bed hospitals in the United States and Canada have adopted it.

Surely, the time for debate has passed. It is beside the mark to argue the wisdom of a movement which has enlisted the co-operation of three-fourths of hospital America. Any advance in medicine must begin—and end—with the welfare of the patient. He must be at once the actuating impulse and the final beneficiary. Just so surely as the patient is benefited, so also will be the doctor and the hospital. And, precisely, because the minimum standard was evolved to bring every group in the hospital together to work for the patient, it has created an organization which has resulted in better work for the individual surgeon, internist, hospital superintendent, and nurse.

The minimum standard embodies the basic principles of scientific research. Research begins with securing facts, compiling facts, analyzing facts. This done, research draws tentative conclusions gained from analysis of the facts. These conclusions, if supported by sufficient evidence and corroborated by practice, become known as scientific truths.

This standard consists of a working arrangement by which these same principles of research are applied daily in the hospital for the benefit of the patient. Accurate, adequate case records, modern laboratory equipment manned by skilled technicians—what are these but provisions to marshal the facts before the physician for examination? The monthly clinical staff meeting—what is this but an opportunity to test out the data which the records and laboratories have furnished? Insistence on competent and ethical practitioners—what is this but a guarantee that the interpreters of the facts regarding each patient are skilled medical men, on whose judgment the public has every right to rely? The working formula for this program is the minimum standard which follows:

THE MINIMUM STANDARD

1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is "open" or "closed," nor need it affect the various existing types of staff organization. The word *staff* is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the "regular staff," the "visiting staff," and the "associate staff."

2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, and policies specifically provide:

   a. That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.)

   b. That the staff review and analyze at regular intervals the clinical experience of the staff in the various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analyses.

4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in an emergency, which includes the personal history; the physical examination, with clinical, pathological, and X-ray findings when indicated; the working diagnosis; the treatment, medical and surgical; the medical progress; the condition on discharge with final diagnosis; and, in case of death, the autopsy findings when available.

5. That clinical laboratory facilities be available for the study, diagnosis, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluroscopic service in charge of trained technicians.

The minimum standard is, in essence, an arrangement by which the hospital can insure its patients the best care known to the science of

medicine. We have shown how it provides an application of the principles of scientific research to the care of the patient—the same principles which the individual doctor or surgeon uses for arriving at a diagnosis. And because medical men the country over were quick to see not only the practical but the scientific basis underlying the minimum standard, they have given it, in increasing numbers, their unqualified support.

It is easy to devise a system of rules which—on paper—is perfect. It is quite another matter to evolve a standard of such simplicity that it stands the test of actual conditions in hospital work. Whether the minimum standard is eminently practicable in the every day administration of hospitals is best answered by the following report:

THE ACCEPTANCE OF THE PROGRAM

In 1918, of the general hospitals of one hundred or more beds in the United States and Canada, 89 met the standard. In 1919, 198 fulfilled the requirements; in 1920, 407, or 57 per cent, met the standard; and this year 568 or 74 per cent of the 761 general hospitals are on the "approved" list.

Further, what has been the experience of other organizations interested in hospital betterment? Manifestly, their reaction toward the program furnishes another reliable index as to its applicability. A decided impetus has been given to hospital standardization by the acceptance and endorsement of the minimum standard by such influential and powerful organizations as the American Hospital Association, the Canadian Medical Association, the Catholic Hospital Association, the Conference Board of Hospitals and Homes of the Methodist Church, the Medical and Surgical Section of the American Railway Association, the Methodist Hospital Association, the Protestant Hospital Association, and numerous state, provincial, and local organizations.

What do hospital superintendents of experience think of the minimum standard after they have seen it in actual operation for a period of years? Quick to recognize its advantages, their endorsements have been numerous. The following quotation from Mr. Frank Chapman, Director of the Mt. Sinai Hospital, Cleveland, serves as a representative example:

"Certainly, the establishment of a laboratory for purposes of check is just as essential in handling human life, as in handling inert commodities. Certainly the recording of a performance is just as essential in a hospital as are the production records of any manufacturing plant. It is undebatable that the only exact way of improving our future performance is on a basis of study of our actual performa nce in the past, and certainly the basis of that study must be as exact as it is humanly possible to make it. Therefore, the establishment of a practice of routine complete case histories is, without a doubt, sound. The desirability, and in fact necessity, of a laboratory is equally undebatable. The necessity for regular staff meetings at which can be discussed, in an impersonal and unbiased way, the performance of that staff, cannot help but be productive of great good to the performance of the whole. Is it not these things and these things alone that the College is asking for in its minimum standard?

"These procedures do not require large expenditures of money, but they do require a very material increase in expenditure of energy and endeavor, and require bringing to the problem of hospital administration an ideal of scientific medical practice that, if followed, cannot help but bring the hospital performance of the country as a whole to a higher plane, than has ever been attained in the past."

As another instance, the following opinion from Dr. Louis H. Burlingham, superintendent of the Barnes Hospital, St. Louis, is presented:

"To reduce the whole problem to its simplest terms, I believe it a self-evident fact that any hospital superintendent would prefer to be connected with a hospital where every patient is guaranteed the best possible care. There is no question that the minimum standard as set forth by the American College of Surgeons contributes markedly toward this end. Therefore, if he has any criticism it can only be that the standard does not perhaps go quite far enough."

Hospital staff-members have been similarly responsive, as is evidenced by this viewpoint from a surgeon, Dr. Irvin Abell, of Louisville, Kentucky:

"Now that the ideals of hospital standardization have been demonstrated to be advisable and attainable and are in process of consummation, the advantages both to the physician and patient are so potent one marvels that the recognition of their need has been so tardy.

"Standardization does not imply commercialism; this would be as objectionable in the medical profession as in the profession of the ministry. But it does imply that all patients, rich and poor, receiving treatment in recognized hospitals will be assured of competent and efficient service fully meeting the requirements and standards which knowledge, experience, and humanitarism demand as the unequivocal right of the sick at the

hands of those to whom their health and well-being are entrusted.

"It applies the great moral force of man's duty to man, which by its appeal to reason as well as to the heart leads the hospital authorities and the doctors practicing in such institutions so to realize the modern addenda to medical and surgical knowledge and so to correlate the work of hospital management with the work of doctors, nurses, and technicians, that the patient is assured of proper and competent treatment in so far as it is humanly possible to secure it."

THE METHOD AND SCOPE OF THE WORK

The hospital surveys of the College are conducted through a trained corps of hospital visitors, all of whom are graduates in medicine. Their purpose is to explain the minimum standard, to interpret its application to each hospital, and to offer constructive criticism and helpful suggestions to remedy any existent shortcomings. Upon these detailed personal surveys, the College is dependent for an accurate estimate of each hospital's status relative to the minimum standard.

An important adjunct to the work of the hospital surveyors has been the emphasis placed on hospital standardization at the state and provincial sectional meetings of the College. At these meetings conferences are held which are devoted to a discussion of pertinent hospital problems by those intimately connected with hospitals. In addition, the community interest is stimulated at public meetings where the benefits of hospital standardization are portrayed.

In 1920, the general hospitals of one hundred or more beds in the United States and Canada were visited. A complete report of the survey of 1920 is contained in bulletin No. 1, Vol. V, issued by the College in January, 1921. This year particular attention has been directed toward those hospitals which in 1920 either were not included in the list, or which were listed with an asterisk. Hospitals which were fully approved in 1920 were not as a routine visited this year, although in all probability visits to these institutions will be resumed in the future.

In addition, 704 general hospitals of fifty to one hundred beds were visited during the past two years; 306 in 1920 and 398 in 1921. As there are approximately 854 of these smaller hospitals in the United States and Canada, 150 remain to be visited. Of these 704 visited during 1920 and 1921, 176, or 25 per cent of the total number, met the standard. The individual listing of this group of institutions will appear next year.

THE PROGRAM FOR THE FUTURE

Consequently, the survey of 1922 will be extended to include all general hospitals of fifty or more beds in the United States and Canada. Of these institutions already visited, many showed a working knowledge of the minimum standard and evinced an active desire to cooperate. The percentage of these meeting the standard at their first visit compares favorably with the percentage of hundred bed hospitals which were approved on their first inspection. If proof were needed of the universal application of the minimum standard, the acceptance by the smaller hospitals would furnish it. Stressing only broad fundamentals, the minimum standard molds itself to meet specific needs, nowhere impeding initiative or fettering judgment. Rightly conceived and carried out, it makes the hospital the proved guardian of the community health, rendering scientific service to all.

LIST OF APPROVED HOSPITALS[1]

Capacity of 100 Beds and More

The following list contains the names of those general hospitals of one hundred or more beds, in the United States and Canada, which meet the minimum standard. In this list a certain number of the institutions are designated with an asterisk. This group includes those hospitals which, when visited, had adopted the fundamental principles of the minimum standard, but which at that time had not had sufficient opportunity to develop all of them to a degree meriting the fullest approval. The hospitals listed without an asterisk, having instituted these measures at an earlier date, had received the benefits of a longer experience in the workings of the program and consequently a broader conception of its application.

[1] This list is complete only to October 4, when this bulletin went to press. Any subsequent changes, if necessary, will appear in the bulletin on hospital standardization which will appear in January, 1922.

UNITED STATES

ALABAMA

Employees Hospital, T. C. I. & R. R. Co., Birmingham
*Hillman Hospital, Birmingham
Mobile City Hospital, Mobile
South Highlands Infirmary, Birmingham

ARKANSAS

*Logan H. Roots Memorial Hospital, Little Rock
St. Louis Southwestern Hospital, Texarkana
St. Vincent's Hospital, Little Rock

CALIFORNIA

Alameda County Hospital, San Leandro
Children's Hospital, San Francisco
*Franklin Hospital, San Francisco
*French Hospital, San Francisco
*Hospital of the Good Samaritan, Los Angeles
Lane Hospital, San Francisco
Los Angeles County Hospital, Los Angeles
Mary's Help Hospital, San Francisco
Mt. Zion Hospital, San Francisco
*O'Connor Sanitarium, San Jose
Pasadena Hospital, Pasadena
*Providence Hospital, Oakland
St. Francis' Hospital, San Francisco
St. Joseph's Hospital, San Francisco
St. Joseph's Sanitarium, San Diego
*St. Luke's Hospital, San Francisco
St. Mary's Hospital, San Francisco
St. Vincent's Hospital, Los Angeles
San Diego County Hospital, San Diego
San Francisco Hospital, San Francisco
*San Joaquin County Hospital, French Camp
Santa Barbara Cottage Hospital, Santa Barbara
Santa Clara County Hospital, San Jose
Santa Fe Coast Lines Hospital, Los Angeles
Southern Pacific Hospital, San Francisco
*Stanford Hospital, San Francisco
University of California Hospital, San Francisco
White Memorial Hospital, Los Angeles

COLORADO

*Denver City and County Hospital, Denver
Glockner Sanatorium and Hospital, Colorado Springs
*Mercy Hospital, Denver
Minnequa Hospital, Pueblo
*St. Anthony's Hospital, Denver
*St. Francis' Hospital, Colorado Springs
*St. Mary's Hospital, Pueblo

CONNECTICUT

Bridgeport Hospital, Bridgeport
Grace Hospital, New Haven
Greenwich General Hospital, Greenwich
Hartford Hospital, Hartford
Lawrence and Memorial Associated Hospitals, New London
New Haven Hospital, New Haven
St. Francis' Hospital, Hartford
St. Mary's Hospital, Waterbury
St. Vincent's Hospital, Bridgeport
*Stamford Hospital, Stamford
Waterbury Hospital, Waterbury

DELAWARE

Delaware Hospital, Wilmington

DISTRICT OF COLUMBIA

Central Dispensary and Emergency Hospital, Washington
Children's Hospital, Washington
Columbia Hospital for Women, Washington
Freedman's Hospital, Washington
Garfield Memorial Hospital, Washington
George Washington University Hospital, Washington
Georgetown University Hospital, Washington
Providence Hospital, Washington
*Washington Sanitarium, Washington

GEORGIA

Georgia Baptist Hospital, Atlanta
Grady Memorial Hospital, Atlanta
University Hospital, Augusta

IDAHO

St. Alphonsus Hospital, Boise

ILLINOIS

Alexian Brothers' Hospital, Chicago
*American Hospital, Chicago
Augustana Hospital, Chicago
Chicago Lying-In Hospital, Chicago
Children's Memorial Hospital, Chicago
Columbus Hospital, Chicago
Cook County Hospital, Chicago
Evanston Hospital, Evanston
*Frances E. Willard Hospital, Chicago
Grant Hospital, Chicago
Hahnemann Hospital, Chicago
Illinois Central Hospital, Chicago
*Illinois Charitable Eye and Ear Infirmary, Chicago
*John C. Proctor Hospital, Peoria
Mercy Hospital, Chicago
Michael Reese Hospital, Chicago
Presbyterian Hospital, Chicago
Rockford Hospital, Rockford
St. Anne's Hospital, Chicago
St. Bernard's Hospital, Chicago
*St. Elizabeth's Hospital, Chicago
*St. Elizabeth's Hospital, Danville
St. Francis' Hospital, Blue Island
*St. Francis' Hospital, Evanston
*St. Francis' Hospital, Peoria
St. Joseph's Hospital, Chicago
St. Luke's Hospital, Chicago
*St. Mary's Hospital, Cairo
*St. Mary's Hospital, East St. Louis
St. Mary's Hospital, La Salle
St. Mary of Nazareth Hospital, Chicago
*St. Vincent's Hospital, Belleville
South Shore Hospital, Chicago
Swedish Covenant Hospital, Chicago
Wesley Memorial Hospital, Chicago

INDIANA

Indianapolis City Hospital, Indianapolis
Methodist Episcopal Hospital, Indianapolis
Robert W. Long Hospital, Indianapolis
St. Anthony's Hospital, Terre Haute
St. Elizabeth's Hospital, LaFayette
St. Joseph's Hospital, Fort Wayne
St. Margaret's Hospital, Hammond
St. Mary's Hospital, Evansville
St. Mary's Mercy Hospital, Gary
St. Vincent's Hospital, Indianapolis

IOWA

Finley Hospital, Dubuque
Iowa Lutheran Hospital, Des Moines
Jennie Edmundson Hospital, Council Bluffs
Mercy Hospital, Council Bluffs
Mercy Hospital, Davenport
*Mercy Hospital, Des Moines

St. Francis' Hospital, Waterloo
St. Joseph's Mercy Hospital, Dubuque
St. Joseph's Mercy Hospital, Sioux City
St. Vincent's Hospital, Sioux City
University Hospital, Iowa City

KANSAS

*Bethany Methodist Hospital, Kansas City
St. Francis' Hospital, Wichita
St. Margaret's Hospital, Kansas City

KENTUCKY

Good Samaritan Hospital, Lexington
Louisville City Hospital, Louisville
Norton Memorial Infirmary, Louisville
St. Anthony's Hospital, Louisville
*St. Elizabeth's Hospital, Covington
Sts. Elizabeth and Mary Hospital, Louisville
St. Joseph's Hospital, Lexington
St. Joseph's Infirmary, Louisville

LOUISIANA

Charity Hospital, New Orleans
*Hotel Dieu, New Orleans
St. Francis' Hospital, Monroe
T. E. Schumpert Memorial Hospital, Shreveport
Touro Infirmary, New Orleans

MAINE

Eastern Maine General Hospital, Bangor
*St. Mary's General Hospital, Lewiston

MARYLAND

Bay View City Hospital, Baltimore
Church Home and Infirmary, Baltimore
*Franklin Square Hospital, Baltimore
Hebrew Hospital and Asylum, Baltimore
Hospital for Women of Maryland, Baltimore
Johns Hopkins Hospital, Baltimore
Maryland General Hospital, Baltimore
Mercy Hospital, Baltimore
Morrow Hospital, Baltimore
St. Agnes' Hospital, Baltimore
St. Joseph's Hospital, Baltimore
Union Memorial Hospital, Baltimore
University Hospital, Baltimore

MASSACHUSETTS

Boston City Hospital, Boston
Brockton Hospital, Brockton
*Burbank Hospital, Fitchburg
Cambridge City Hospital, Cambridge
Carney Hospital, Boston
Children's Hospital, Boston
City Hospital, Fall River
*Cooley-Dickinson Hospital, Northampton
Holyoke City Hospital, Holyoke
Lawrence General Hospital, Lawrence
Long Island Hospital, Boston
Lowell Corporation Hospital, Lowell
Lowell General Hospital, Lowell
Lynn Hospital, Lynn
Massachusetts General Hospital, Boston
Massachusetts Homeopathic Hospital, Boston
Memorial Hospital, Worcester
Mercy Hospital, Springfield
New England Hospital for Women and Children, Boston
Newton Hospital, Newton Lower Falls
Peter Bent Brigham Hospital, Boston
Providence Hospital, Holyoke
St. Elizabeth's Hospital, Boston
St. John's Hospital, Lowell
*St. Luke's Hospital, New Bedford
St. Vincent's Hospital, Worcester
Salem Hospital, Salem
Springfield Hospital, Springfield
Union Hospital, Fall River
Worcester City Hospital, Worcester

MICHIGAN

Battle Creek Sanitarium, Battle Creek
Blodgett Memorial Hospital, Grand Rapids
Butterworth Hospital, Grand Rapids
Children's Free Hospital, Detroit
Detroit Receiving Hospital, Detroit
Grace Hospital, Detroit
Harper Hospital, Detroit
Hackley Hospital, Muskegon
Henry Ford Hospital, Detroit
Highland Park General Hospital, Highland Park
House of Providence, Detroit
St. Joseph's Hospital, Ann Arbor
St. Mary's Hospital, Grand Rapids
St. Mary's Hospital, Detroit
University Hospital, Ann Arbor
University of Michigan Homeopathic Hospital, Ann Arbor
Woman's Hospital and Infant's Home, Detroit

MINNESOTA

Bethesda Hospital, St. Paul
City and County Hospital, St. Paul
Colonial Hospital, Rochester
Deaconess Hospital, Minneapolis
*Eitel Hospital, Minneapolis
*Fairview Hospital, Minneapolis
Minneapolis General Hospital, Minneapolis
Mounds Park Sanitarium, St. Paul
St. Joseph's Hospital, St. Paul
*St. Luke's Hospital, St. Paul
St. Mary's Hospital, Duluth
St. Mary's Hospital, Minneapolis
St. Mary's Hospital, Rochester
*St. Paul Hospital, St. Paul
*Swedish Hospital, Minneapolis
University of Minnesota Hospital, Minneapolis
Worrell Hospital, Rochester

MISSISSIPPI

Matty Hersee Hospital, Meridian

MISSOURI

Alexian Brothers' Hospital, St. Louis
Barnes Hospital, St. Louis
Children's Hospital, Kansas City
*Christian Church Hospital, Kansas City
*Evangelical Deaconess Home and Hospital, St. Louis
Jewish Hospital, St. Louis
Kansas City General Hospital, Kansas City
Lutheran Hospital, St. Louis
*Mullanphy Hospital, St. Louis
Research Hospital, Kansas City
St. Anthony's Hospital, St. Louis
St. John's Hospital, St. Louis
St. Joseph's Hospital, Kansas City
St. Louis Children's Hospital, St. Louis
St. Louis City Hospital, St. Louis

St. Luke's Hospital, St. Louis
St. Mary's Hospital, Kansas City
St. Mary's Infirmary, St. Louis

MONTANA

Columbus Hospital, Great Falls
Montana Deaconess Hospital, Great Falls
Murray Hospital, Butte
St. James' Hospital, Butte
St. Patrick's Hospital, Missoula

NEBRASKA

*Nebraska Methodist Hospital, Omaha
*Nebraska Orthopedic Hospital and Home, Lincoln
St. Elizabeth's Hospital, Lincoln
St. Francis' Hospital, Grand Island
St. Joseph's Hospital, Omaha
*St. Mary's Hospital, Columbus
University of Nebraska Hospital, Omaha

NEW HAMPSHIRE

St. Joseph's Hospital, Nashua

NEW JERSEY

*Alexian Brothers' Hospital, Elizabeth
Atlantic City Hospital, Atlantic City
Bayonne Hospital and Dispensary, Bayonne
Christ Hospital, Jersey City
Cooper Hospital, Camden
Elizabeth General Hospital, Elizabeth
Hackensack Hospital, Hackensack
Jersey City Hospital, Jersey City
Mercer Hospital, Trenton
Monmouth Memorial Hospital, Long Branch
Morristown Memorial Hospital, Morristown
Mountainside Hospital, Montclair
Muhlenberg Hospital, Plainfield
Newark Beth Israel Hospital, Newark
Newark City Hospital, Newark
Newark Memorial Hospital, Newark
Orange Memorial Hospital, Orange
Passaic General Hospital, Passaic
Paterson General Hospital, Paterson
St. Elizabeth's Hospital, Elizabeth
St. Francis' Hospital, Trenton
*St. Joseph's Hospital, Paterson
*St. Mary's Hospital, Hoboken
*St. Michael's Hospital, Newark

NEW YORK

Albany Hospital, Albany
Bellevue Hospital, New York
Beth Israel Hospital, New York
Beth Moses Hospital, Brooklyn
*Binghamton City Hospital, Binghamton
Broad Street Hospital, New York
Brooklyn Hospital, Brooklyn
Brownsville and East New York Hospital, Brooklyn
Buffalo City Hospital, Buffalo
Buffalo General Hospital, Buffalo
*Buffalo Homeopathic Hospital, Buffalo
*Buffalo Hospital of Sisters of Charity, Buffalo
*Bushwick Hospital, Brooklyn
Carson C. Peck Memorial Hospital, Brooklyn
*Children's Hospital, Buffalo
Clifton Springs Sanitarium, Clifton Springs
Community Hospital, New York
Coney Island Hospital, Brooklyn
*Crouse-Irving Hospital, Syracuse
Cumberland Street Hospital, Brooklyn
Ellis Hospital, Schenectady
*Flower Hospital, New York
Flushing Hospital and Dispensary, Flushing
Fordham Hospital, New York
French Benevolent Hospital, New York
*Good Shepherd Hospital, Syracuse
Gouverneur Hospital, New York
Greenpoint Hospital, Brooklyn
Hahnemann Hospital, New York
Hahnemann Hospital, Rochester
Harlem Hospital, New York
Holy Family Hospital, Brooklyn
Homeopathic Hospital, Albany
Jewish Hospital, Brooklyn
Kings County Hospital, Brooklyn
Lebanon Hospital, New York
*Lenox Hill Hospital, New York
Lincoln Hospital, New York
Long Island College Hospital, Brooklyn
*Manhattan Eye and Ear Hospital, New York
Memorial Hospital, New York
Methodist Episcopal Hospital, Brooklyn
Metropolitan Hospital, New York
Misericordia Hospital, New York
Mount St. Mary's Hospital, Niagara Falls
Mount Sinai Hospital, New York
*Mount Vernon Hospital, Mount Vernon
New York City Hospital, Blackwell's Island, New York
*New York Eye and Ear Infirmary, New York
*New York Foundling Home, New York
New York Hospital, New York
New York Infirmary for Women and Children, New York
New York Nursery and Children's Hospital, New York
New York Orthopedic Hospital, New York
New York Post-Graduate Hospital, New York
New York Hospital for Ruptured and Crippled, New York
New York Skin and Cancer Hospital, New York
*New York State Hospital for Crippled Children, West Haverstraw
*Niagara Falls Memorial Hospital, Niagara Falls
Norwegian Lutheran Deaconess Hospital, Brooklyn
*Oneida County Hospital, Rome
Presbyterian Hospital, New York
Rochester General Hospital, Rochester
Rochester Homeopathic Hospital, Rochester
Roosevelt Hospital, New York
St. Catherine's Hospital, Brooklyn
St. Francis' Hospital, New York
St. John's Brooklyn Hospital, Brooklyn
St. John's Hospital, Long Island
St. John's Riverside Hospital, Yonkers
*St. Joseph's Hospital, Syracuse
St. Luke's Hospital, New York
St. Mark's Hospital, New York
St. Mary's Free Hospital for Children, New York
St. Mary's Hospital, Brooklyn
*St. Mary's Hospital, Rochester
*St. Peter's Hospital, Albany
*St. Peter's Hospital, Brooklyn
St. Vincent's Hospital, New York
Samaritan Hospital, Troy
Sloane Hospital for Women, New York
Staten Island Hospital, Tompkinsville
Syracuse Memorial Hospital, Syracuse
Troy Hospital, Troy
Woman's Hospital, New York
Wyckoff Heights Hospital, Brooklyn
*Yonkers Homeopathic Hospital, Yonkers

NORTH CAROLINA

*Watts Hospital, West Durham

NORTH DAKOTA

Bismarck Evangelical Deaconess Hospital, Bismarck
*Grand Forks Deaconess Hospital, Grand Forks
St. Alexius' Hospital, Bismarck
St. John's Hospital, Fargo
St. Luke's Hospital, Fargo

OHIO

*Aultman Hospital, Canton
Bethesda Hospital, Cincinnati
Christ Hospital, Cincinnati
Cincinnati General Hospital, Cincinnati
City Hospital of Akron, Akron
Cleveland City Hospital, Cleveland
Good Samaritan Hospital, Cincinnati
Good Samaritan Hospital, Zanesville
Grant Hospital, Columbus
Hawkes Hospital of Mount Carmel, Columbus
Jewish Hospital, Cincinnati
Lakeside Hospital, Cleveland
Miami Valley Hospital, Dayton
*Mercy Hospital, Hamilton
Mount Sinai Hospital, Cleveland
*Peoples Hospital, Akron
*Protestant Hospital Association, Columbus
St. Alexis' Hospital, Cleveland
St. Elizabeth's Hospital, Youngstown
St. Francis' Hospital, Columbus
St. John's Hospital, Cleveland
*St. Luke's Hospital, Cleveland
St. Mary's Hospital, Cincinnati
St. Rita's Hospital, Lima
St. Vincent's Hospital, Cleveland
St. Vincent's Hospital, Toledo
Springfield City Hospital, Springfield
Toledo Hospital, Toledo
*Youngstown Hospital, Youngstown

OKLAHOMA

St. Anthony's Hospital, Oklahoma
State University Hospital, Oklahoma

OREGON

Emanuel Hospital, Portland
St. Vincent's Hospital, Portland

PENNSYLVANIA

Allegheny General Hospital, Pittsburgh
Allentown Hospital, Allentown
Altoona Hospital, Altoona
Braddock General Hospital, Braddock
Chester County Hospital, West Chester
Chester Hospital, Chester
Children's Homeopathic Hospital, Philadelphia
Clearfield Hospital, Clearfield
Columbia Hospital, Pittsburgh
Conemaugh Valley Memorial Hospital, Johnstown
Easton Hospital, Easton
*Elizabeth Steel Magee Hospital, Pittsburgh
Frankford Hospital, Philadelphia
George F. Geisinger Hospital, Danville
Germantown Dispensary and Hospital, Philadelphia
Hahnemann Medical College Hospital, Philadelphia
*Hamot Hospital, Erie
Harrisburg Hospital, Harrisburg
Homeopathic Medical and Surgical Hospital, Pittsburgh
Hospital of the Protestant Episcopal Church, Philadelphia
Hospital of the University of Pennsylvania, Philadelphia
Hospital of the Women's Medical College, Philadelphia
Jefferson Medical College Hospital, Philadelphia
Jewish Hospital, Philadelphia
Lancaster General Hospital, Lancaster
Lankenau Hospital, Philadelphia
*Medical, Surgical, and Maternity Hospital of the Women's Homeopathic Association, Philadelphia
Medico-Chirurgical Hospital, Philadelphia
*Memorial Hospital, Philadelphia
Mercy Hospital, Johnstown
Mercy Hospital, Pittsburgh
Mercy Hospital, Wilkes-Barre
Methodist Episcopal Hospital, Philadelphia
Misericordia Hospital, Philadelphia
Moses Taylor Hospital, Scranton
Passavant Hospital, Pittsburgh
Pennsylvania Hospital, Philadelphia
Philadelphia General Hospital, Philadelphia
Philadelphia Polyclinic Hospital, Philadelphia
Pittsburgh Hospital, Pittsburgh
Pottsville Hospital, Pottsville
Presbyterian Hospital, Philadelphia
Presbyterian Hospital, Pittsburgh
Reading Hospital, Reading
*Robert Packer Hospital, Sayre
Sacred Heart Hospital, Allentown
St. Agnes' Hospital, Philadelphia
St. Francis' Hospital, Pittsburgh
*St. John's General Hospital, Pittsburgh
*St. Joseph's Hospital, Lancaster
St. Joseph's Hospital, Philadelphia
St. Joseph's Hospital, Pittsburgh
St. Luke's Hospital, South Bethlehem
St. Margaret's Hospital, Pittsburgh
St. Mary's Hospital, Philadelphia
St. Vincent's Hospital, Erie
Samaritan Hospital, Philadelphia
South Side Hospital, Pittsburgh
*State Hospital for Injured Persons, Ashland
State Hospital of the Middle Coal Fields, Hazelton
*State Hospital of the Northern Anthracite Coal Regions, Scranton
*Western Pennsylvania Hospital, Pittsburgh
Wilkes-Barre City Hospital, Wilkes-Barre
Wills Hospital, Philadelphia
Woman's Hospital, Philadelphia
York Hospital and Dispensary, York

RHODE ISLAND

Rhode Island Hospital, Providence
St. Joseph's Hospital, Providence

SOUTH CAROLINA

Chick Springs Sanitarium, Chick Springs
Florence Infirmary, Florence
Roper Hospital, Charleston

SOUTH DAKOTA

McKennan Hospital, Sioux Falls
*St. Luke's Hospital, Aberdeen

TENNESSEE

Baptist Memorial Hospital, Memphis
Erlanger Hospital, Chattanooga
Memphis General Hospital, Memphis
St. Joseph's Hospital, Memphis
St. Thomas' Hospital, Nashville

TEXAS

Baptist Sanitarium and Hospital, Houston
Baylor Hospital, Dallas
John Sealy Hospital, Galveston
*Parkland Hospital, Dallas
Providence Hospital, Waco
Robert B. Green Memorial Hospital, San Antonio
St. Joseph's Infirmary, Fort Worth
St. Joseph's Infirmary, Houston
St. Mary's Infirmary, Galveston
St. Paul's Sanitarium, Dallas
Santa Rosa Infirmary, San Antonio
Temple Sanitarium, Temple

UTAH

*Doctor W. H. Groves Latter Day Saints Hospital, Salt Lake City
Holy Cross Hospital, Salt Lake City
St. Mark's Hospital, Salt Lake City

VERMONT

Mary Fletcher Hospital, Burlington

VIRGINIA

Hospital Division of the Medical College of Virginia, Richmond
Norfolk Protestant Hospital, Norfolk
St. Vincent's Hospital, Norfolk
University of Virginia Hospital, Charlottesville
Virginia Hospital, Richmond

WASHINGTON

Children's Orthopedic Hospital, Seattle
Columbus Sanitarium, Seattle
*Northern Pacific Hospital, Tacoma
Providence Hospital, Seattle
Sacred Heart Hospital, Spokane
St. Elizabeth's Hospital, North Yakima
St. Joseph's Hospital, Tacoma
St. Luke's Hospital, Spokane
Seattle City Hospital, Seattle
Seattle General Hospital, Seattle
Swedish Hospital, Seattle
Tacoma General Hospital, Tacoma

WEST VIRGINIA

*Charleston General Hospital, Charleston
Kessler-Hatfield Hospital, Huntington
Ohio Valley General Hospital, Wheeling
St. Mary's Hospital, Clarksburg
Sheltering Arms Hospital, Hansford
*Wheeling Hospital, Wheeling

WISCONSIN

LaCrosse Lutheran Hospital, LaCrosse
Luther Hospital, Eau Claire
Madison General Hospital, Madison
Milwaukee County Hospital, Milwaukee
*Milwaukee Hospital, Milwaukee
Mount Sinai Hospital, Milwaukee
Sacred Heart Hospital, Eau Claire
St. Agnes' Hospital, Fond du Lac
St. Francis' Hospital, LaCrosse
St. Joseph's Hospital, Marshfield
St. Joseph's Hospital, Milwaukee
St. Mary's Hospital, Green Bay
*St. Mary's Hospital, Superior
Trinity Hospital, Milwaukee

CANADA

ALBERTA

General Hospital, Calgary
*General Hospital, Edmonton
General Hospital, Medicine Hat
Holy Cross Hospital, Calgary
*Royal Alexandra Hospital, Edmonton

BRITISH COLUMBIA

Provincial Royal Jubilee Hospital, Victoria
Royal Columbia Hospital, New Westminster
Royal Inland Hospital, Kamloops
St. Joseph's Hospital, Victoria
St. Paul's Hospital, Vancouver
Vancouver General Hospital, Vancouver

MANITOBA

Children's Hospital, Winnipeg
General Hospital, Winnipeg
Misericordia Hospital, Winnipeg
St. Boniface Hospital, St. Boniface

NEW BRUNSWICK

General Hospital, St. John

NOVA SCOTIA

St. Joseph's Hospital, Glace Bay
Victoria General Hospital, Halifax

ONTARIO

*General Hospital, Hamilton
General Hospital, Kingston
Grace Hospital, Toronto
Hospital for Sick Children, Toronto
Hotel Dieu, Kingston
St. Michael's Hospital, Toronto
*Toronto General Hospital, Toronto
Victoria General Hospital, London

QUEBEC

Children's Memorial Hospital, Montreal
Hotel Dieu, Montreal
Jeffrey Hale Hospital, Quebec
Montreal General Hospital, Montreal
Notre Dame Hospital, Montreal
Royal Victoria Hospital, Montreal
*Western Hospital, Montreal

SASKATCHEWAN

City Hospital, Saskatoon
Grey Nun's Hospital, Regina
Regina General Hospital, Regina
St. Paul's Hospital, Saskatoon

MY EXPERIENCE AS A SURGEON WITH THE STANDARDIZATION PROGRAM[1]

By M. G. SEELIG, M.D., F.A.C.S., St. Louis

COUNTRIES, states, universities, and institutes have their ups and downs of intellectual activity. There was a time several decades ago when Missouri occupied a vanguard position in medical science, and when her roster contained names to conjure with. This statement is made not in order to carry the implication that our state is today in her senescence; it is made rather to introduce the fact that when Missouri was in her greatest medical glory, the art of surgery was practically non-existent. Antisepsis, for example, was not dreamed of at that time. It is reported that during this early period, one of the leaders of St. Louis surgery stated that he had performed five laparotomies, and had to show for them, five graves out in Bellefontaine. Clearly what surgery needed in those days was not a program of standardization but rather in the language of Goethe "more light." This light was needed not only in Missouri, but wherever surgery was practiced.

The light finally dawned; first anæsthesia, then antisepsis, then asepsis, then better nursing, better hospitals, better medical schools, and finally better medical students and graduates. The field of surgery broadened, her cures became more numerous, her possibilities more widely recognized and appreciated, and her material rewards magnified. Just here the trouble began. The political economists teach us that capital is a fluid medium, and that it flows hither and thither where the attraction is greatest. It slowly came about that mounting surgical fees resulted in a numerical increase of surgeons constituting so-called attraction centers for the smoothly flowing current of loose capital. Unfortunately this numerical increase of surgeons was not based on any special fitness to practice surgery. From such a type of development there could be only one result, an overcrowded field run wild with the dank undergrowth and tares of incompetency and commercialism. This is not the occasion nor is there any need to point out these evils in detail. It will suffice to say that five years ago fee splitting and kindred evils were rapidly assuming the proportion of full-fledged stenches.

It goes without saying that the greatest sufferer from these various evils was surgery herself. Her good name and repute, the enviable position that she had won only by the most arduous efforts, dating back to the barber surgeon days of 1500, her integrity as a worthy handmaiden to medicine—all these were in the balance. The lay community also suffered to no less degree. No sick layman is safe in the hands of a commercial surgeon. There is no exception to this rule. No sick layman is safe in the hands of an improperly trained or poorly qualified surgeon. There is no exception to this rule. When the number of commercial surgeons and improperly trained and poorly qualified surgeons becomes large enough, the task of the layman in picking his surgical advisor becomes almost hopelessly difficult. We had about reached this stage when, through the agency of the American College of Surgeons, the program of standardization was initiated.

In detailing to you my own personal experience as a surgeon with this program, let me say by way of explanation that I have not enjoyed the privilege of knowing just what was the fullness of the plan in the remarkable mind of Dr. Franklin Martin, and in the minds of his colleagues and counsellors when they started the American College of Surgeons. The eradication of fee splitting seemed to be one of the outstanding issues, and on this issue I was useless as an aid. This practice has always seemed to me so purely a question of personal morals that I have always regarded it as belonging only to the provinces of the priesthood or the police. My interest in improving the qualification of the young surgeon, on the other hand, has been keen, and I have been privileged for years to indulge this interest through contact with medical students and by humbly insignificant dissertations on medical teaching. It slowly dawned on me, as I am sure it must have dawned on every other teacher, that precepts only too often lost their force and edge, when the young practitioner faced the problems incident to practice. Men possessing all the qualifications of brilliant promise have failed to run true to form, others have thrown the race, and still others have fluked or fouled. These were the facts in the case. It was much easier to recognize them than to apply a remedy.

As I look back over my very short contact and experience with the standardization program of the American College of Surgeons, I begin to

[1] Read before the Missouri State Section Clinical Congress of American College of Surgeons, St. Louis, March 10-11, 1921.

appreciate just what was the thought that I have previously referred to as being in the back of the minds of the organizers of the College. I remember the various statutes suggested and actually enacted to control surgical practice. I recall the birth of various organizations of surgeons aimed at emphasizing the special fitness necessary for membership. I think of various other ill-defined and inarticulate reforms or movements toward elevating surgical practice. And as I call all these pictures to mind I realize clearly how little was accomplished in each instance. The reasons for scanty accomplishment are perfectly simple and I believe that we may assume that the program of the college is based on these reasons.

In the first place activities such as surgery calls into play, can be most safely and most surely regulated from within. By this I mean that the development of the noblest impulses and the creation of the purest traditions must in the last analysis come from the very heart of surgery herself; not from the heart of St. Louis surgery, or Philadelphia surgery, or Ohio surgery, or surgery of the East or West, but from all surgery—in respect to this belief I am an internationalist. Any reform or any movement aimed at the betterment of surgery which is not all embracing in its scope is unequivocally stamped as an insignificant success or a failure.

Secondly, the art of surgery lies in remedying or curing surgical disease. The vast majority of surgical cures are purchased. If we hope to safeguard the standard of the commodity we sell, we must educate the layman to the point where he becomes an intelligent purchaser. Again it becomes clearly evident that surgery profits slightly if only the St. Louis, or the Boston, or the New York purchasers are intelligent and discriminating, it profits little even if the city dwellers as a whole display discretion and judgment in selecting their surgeons, as contrasted with a hopeless helplessness on the part of rural invalids. The least the sick man, the world over, can demand, is some legitimate basis of selection on which he may rely in choosing a surgeon.

The program of standardization as I have come in contact with it, is working out along both these lines. Men, conscious of moral or professional limitations barring them from the College, are struggling to correct their defects; recent graduates are planning and so ordering their activities as to furnish warrant for their admission at the earliest moment; the members of the College themselves are consulting the roster more and more frequently when it becomes necessary to refer patients to surgeons away from home, and medical students are beginning to know which of their instructors are members of the College. In other words, one can detect the ferment of the spirit of the guild beginning to work. And it is a sort of universalized chemical reaction, as clearly patent in Texas as in Maine, and in California as in Massachusetts. In other words, the force is coming from within, from the heart of surgery herself. Whatever objection or typically democratic American resentment there might have been against being passed in review before a qualifying board, has given way to the spirit of the movement—better surgeons.

The relationship between the standardization program and the layman is a most interesting one. In most communities the word hospital signifies brick and mortar containers for sick people. It means this not merely to the community at large, but only too frequently to the members of boards of directors themselves. Quite unexpectedly these boards of directors found themselves face to face with an agency which, to use the words of Mr. Bowman, was selling the idea of hospital efficiency. As far as my own experience goes, I can certify to the facts that the idea was sold to them and that they value their purchase. My own board realizes, as never before, what records mean, they are awake to the importance of all varieties of hospital interdepartmental co-operation and they have gone through the period of school boy suspense waiting to see how they would be graded.

What does this mean? It means a beginning of educating the layman to understand and appreciate the real functions of a hospital. Such understanding and appreciation carries with it the corollary that layman will be better able to appreciate and estimate the services of the medical staff. The rendering of adequate medical service begins to take form in the lay mind as a very concrete idea.

To sum up then, in just a word, the program of standardization, as I interpret, has resulted in the first place in stimulating surgery to higher and better efforts. It has done this by a subtle strengthening of *esprit de corps*, and by setting the great body of surgeons to work doing their own house cleaning on an adequately comprehensive scale. In the second place it has resulted in starting the education of groups of laymen, scattered throughout our country. Education is highly infectious, and one may safely hope that knowledge will spread until the average intelligent layman will show at least a glimmer of rationality in selecting his surgeon and in matters pertaining to hospital ideals.